Engineering Library

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The Engineer.

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VOL. CL.—No. 3909] LONDON: FRIDAY EVENING, DECEMBER 12, 1930 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

The Engineer

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PUBLIC NOTICES

HEATING.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Tuesday, 30th December, 1930, for INSTALLATION of HEATING APPARATUS at the Post Office and Telephone Exchange, Wisbech.

Drawings, specification, a copy of the conditions and form of contract, bills of quantities and forms for Tender, may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea. (Cheques payable to The Commissioners, H.M. Office of Works.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 6224

The Director-General, India Store Department, Belvedere-road, Lambeth, London, S.E. 1, invites TENDERS for :—
500 CHAMBERS, VACUUM, GALVANISED, 16in. diam.
Tenders due 19th December, 1930.
Forms of Tender available from the above at a fee of 5s. which will not be returned. 6221

The Government of BENGAL invite APPLICATIONS for an APPOINTMENT as EXECUTIVE ENGINEER, Western (Electrical) Division, Calcutta. Candidates must have at least three years' practical experience in an Electrical or Mechanical Engineering Workshop or Electric Power Station and subsequently at least five years' regular practice of Electrical Engineering. Sound theoretical knowledge of Electrical Engineering essential. A Degree in Electrical Engineering and a knowledge of accounts will be an advantage. Age 30-40 years.

Electrical engineers serving under Government in India are eligible, provided they possess qualifications and experience prescribed. In their case upper age limit will not be enforced.

Agreement for five years in first instance. Pay in accordance with an age scale, e.g., age 30, Rs. 725 a month plus overseas pay £25 a month; age 40, Rs. 1175 a month plus overseas pay £30 a month; age 44, Rs. 1325 a month plus overseas pay £30 a month. Approximate sterling equivalent at current rate of exchange £952, £1417 and £1552 per annum. Overseas pay is admissible only to an officer of non-Asiatic domicile. Calcutta house allowance. Free first-class passage to India. Provident Fund. Strict medical examination.

Forms of application and further particulars may be obtained upon request by postcard from the HIGH COMMISSIONER FOR INDIA, General Department, India House, Aldwych, London, W.C. 2. Last date for the receipt of applications 31st December, 1930. 6196

Administrative County of LONDON.
The London County Council invites TENDERS for the SUPPLY and DELIVERY to the Northern Outfall Works, Beckton, London, E. 6, of about 90 TONS of from 16in. to 81in. CAST IRON PIPES.

The specification, form of Tender, &c., may be obtained on application to the Chief Engineer, Old County Hall, Spring-gardens, S.W. 1, upon payment of £1 by cheque, draft or money order to the order of the London County Council. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application, and the contract documents may be inspected before payment of the fee.

Remittances by post should be addressed to the Chief Engineer, Old County Hall, Spring-gardens, S.W. 1. Personal inquiries at Room 2, No. 3, Warwick House-street, Cockspur-street, S.W. 1.

The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the instructions for Tender and form of contract and in "The London County Council Gazette."

No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 5th January, 1931, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

MONTAGU H. COX,
6218 Clerk of the London County Council.

Administrative County of LONDON.
The London County Council invites TENDERS for the PURCHASE and REMOVAL of the undermentioned BOILERS and PUMPING MACHINERY at Isle of Dogs Pumping Station, Stewarts-street, Poplar, E. 14, viz.:—

Two Cornish Boilers, 6ft. diameter by 22ft. long, with Mountings, Feed Pump, Pipes, &c.
Two Horizontal Steam Engines, each with cylinder 27in. diameter, stroke 3ft., and each driving, through gearing, Two Vertical Single-acting Pumps, 40in. diameter, 4ft. stroke.
A Horizontal Steam Engine, with cylinder 7in. diameter, 10in. stroke, and other Miscellaneous Items.

The specification, form of Tender, &c., may be obtained on application to the Chief Engineer, Old County Hall, Spring-gardens, S.W. 1, upon payment of £1 by cheque, draft, or money order to the order of the London County Council. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application, and the contract documents may be inspected before payment of the fee.

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The Council does not bind itself to accept the highest or any Tender.

MONTAGU H. COX,
6219 Clerk of the London County Council.

Borough of Acton.
OFFERS are INVITED for the PURCHASE of a 10-TON DENISON WEIGHBRIDGE, graduated to 10 tons 19 cwt. 3 qr. 21 lb., with Ticket Printing Attachment.

The weighbridge may be inspected at the site of the Destructor, Wales Farm-road, Acton.

Offers to be submitted to W. G. Cross, Assoc. M. Inst. C.E., Borough Engineer, Municipal Offices, Acton, W. 3, not later than 3 p.m., 7th January, 1931.

JOHN MORGAN,
Town Clerk.
Municipal Offices, Acton, W. 3,
8th December, 1930. 6199

PUBLIC NOTICES

County Borough of Smethwick.
BEARWOOD BATHS.
HEATING AND FILTRATION.
TO HEATING ENGINEERS.

The Estates Committee is prepared to receive TENDERS from reputable firms of Heating Engineers for the SUPPLY and INSTALLATION of LOW-PRESSURE STEAM BOILERS, PUMPS, ELECTRIC MOTORS, PIPING, and the whole of the PLANT required in connection with the HEATING of the SWIMMING BATHS WATER, HOT WATER SUPPLY to SLIPPER BATHS, &c., and the HEATING of the BUILDING in connection with the above scheme.
TO FILTRATION ENGINEERS.

The Committee is also prepared to receive TENDERS for the SUPPLY and INSTALLATION of a complete FILTRATION PLANT to deal with the Swimming Baths Water.

Firms desiring to Tender for either Plant should communicate at once with the undersigned, enclosing deposit of £5, when plans and particulars will be forwarded.

Separate Tenders are required for the Heating and Filtration Plant, and must reach the undersigned not later than first post on Monday, 12th January, 1931.

ROLAND FLETCHER, A.M. Inst. C.E.,
Borough Engineer.
Council House, Smethwick,
1st December, 1930. 6172

High Wycombe.
BOROUGH OF CHEPPING WYCOMBE WATERWORKS.
NEW WELL AND BORING.

TENDERS are INVITED for the WORK of SINKING a WELL, 7ft. in diameter, with a BORING 42in. in diameter, into the chalk formation to a depth of 200ft. from the surface; LINING it with CAST IRON CYLINDERS and STEEL TUBES to a depth of 90ft. from the surface, and TESTING its YIELD at the rate of 150,000 gallons an hour.

Specification and form of Tender may be obtained at the office of Mr. W. Vaux Graham, M. Inst. C.E., 5, Queen Anne's-gate, Westminster, S.W. 1, the Consulting Engineer to the Corporation (on and after Tuesday, December 16th), on payment of Two Guineas, which will be returned on receipt of a bona fide Tender.

Sealed Tenders, endorsed "Tender for Well and Boring," to be delivered to the undersigned not later than first post on Wednesday, January 7th, 1931.

The Corporation do not bind themselves to accept the lowest or any Tender.

S. YOUNG,
Engineer and Manager.
71, Easton-street,
High Wycombe, Bucks. 6210

PUBLIC NOTICES

Bombay, Baroda and Central INDIA RAILWAY.

The Directors are prepared to receive up to Noon on Friday, 2nd January, TENDERS for the SUPPLY of :—

(1) PIG IRON,

and up to Noon on Friday, 23rd January, TENDERS for the SUPPLY of :—

(2) GALVANISED STEEL and IRONWORK.
(3) STEEL MATERIAL "A."

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 10s. each for Nos. 1 and 2, and 20s. for No. 3 (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG,
Secretary.
Offices: The White Mansion,
91, Petty France, Westminster, S.W. 1,
10th December, 1930. 6232

City of Nottingham.
NEW ROAD—RADFORD-ROAD TO NUTHALL-ROAD.
BRIDGE OVER THE L.M. AND S. RAILWAY, MANSFIELD BRANCH.
CONTRACT NO. 3.
TO CONTRACTORS.

The Works and Ways Committee is prepared to receive TENDERS for the CONSTRUCTION of the above BRIDGE, consisting of Concrete and Brick Abutments and Wing Walls, Brick Jack Arches, &c.

Drawings may be seen and copies of the general conditions of contract, specification, bill of quantities, and form of Tender may be obtained on application to Mr. T. Wallis Gordon, City Engineer and Surveyor, Guildhall, Nottingham, on payment of a deposit of Two Pounds, which will be returned on receipt of a bona fide Tender.

Sealed Tenders are to be delivered to the undersigned in the official envelope provided not later than 6 p.m. on Thursday, 8th January, 1931.

The lowest or any Tender will not necessarily be accepted, and Tenders will only be accepted from firms who conform to the conditions of the contract as regards paying the local standard rate of wages, &c., and to the working rules of the Nottingham District.

By Order,
W. J. BOARD,
Town Clerk.
Guildhall, Nottingham,
9th December, 1930. 6211

PUBLIC NOTICES

City of Nottingham.
NEW ROAD—RADFORD-ROAD TO NUTHALL-ROAD.
BRIDGE OVER L.M. AND S. RAILWAY, MANSFIELD BRANCH.
CONTRACT NO. 4.
TO STRUCTURAL ENGINEERS.

The Works and Ways Committee is prepared to receive TENDERS for about 102 TONS of STEEL WORK in Plate Girders, Stanchions, Cross Bracing Floor Ties, Bearing Plates, &c., required in the construction of the above Bridge.

Drawings may be seen and copies of the general conditions of contract, specification, bill of quantities, and form of Tender may be obtained on application to Mr. T. Wallis Gordon, City Engineer and Surveyor, Guildhall, Nottingham, on payment of a deposit of £2, which will be returned on receipt of bona fide Tender.

Sealed Tenders are to be delivered to the undersigned in the official envelopes provided not later than 6 p.m. on Thursday, January 8th, 1931.

The lowest or any Tender will not necessarily be accepted, and Tenders will only be accepted from firms who conform to the conditions of the contracts as regards paying the local standard rate of wages, &c., and to the working rules of the Nottingham District.

By Order,
W. J. BOARD,
Town Clerk.
Guildhall, Nottingham,
9th December, 1930. 6212

Bengal-Nagpur Railway Company, Limited.
The Directors are prepared to receive TENDERS for :—
4000 COLD-DRAWN WELDLESS STEEL BOILER TUBES.

Specification and form of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after Monday, 8th December, 1930.

A fee of 10s. will be charged for each copy of the specification, which is NOT returnable.

Tenders must be submitted not later than Noon on Wednesday, 17th December, 1930.

The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the order.

By Order of the Board,
R. GRANT,
6204 Secretary.

Egyptian Government.
TENDERS are CALLED FOR by the Mechanical Department, Ministry of Public Works, for the SUPPLY and ERECTION at Naga Hamadi Barrage of an ELECTRIC GENERATING and PUMPING PLANT for supplying the Barrage Colony with Electric Current and Water.

Tenders should be submitted direct to the DIRECTOR-GENERAL, Mechanical and Electrical Department, Ministry of Public Works, Cairo, not later than Noon on the 23rd February, 1931.

Copies of the necessary conditions of Tender, specifications and drawings, &c., can be obtained on application to the Chief Inspecting Engineer, Egyptian Government, 41, Tothill-street, S.W. 1, against remittance of £1 0s. 6d. per set, which sum is not returnable. Copies of these documents are also available for scrutiny at the above address.

Firms on the Continent should apply to the Egyptian Consulate in their respective countries for the above-mentioned documents. 6213

Stockport Corporation Waterworks.
GOYT VALLEY SUPPLY.—CONTRACT A.
LAYING TRUNK MAIN—WHALEY BRIDGE TO DISLEY.

TENDERS are INVITED for the LAYING and JOINTING of a LINE of CAST IRON PIPES, 30in. in diameter and about 4 miles in length, along the Main Road between Whaley Bridge and Disley.

The work consists of the excavation of trenches and the laying and jointing of the pipes, refilling of trenches and restoring road surface, together with the fixing of valves and ironwork in connection therewith and the construction of the necessary valve chambers, &c.

Plans and drawings may be seen and specification and form of Tender obtained on application to Messrs. G. H. Hill and Sons (Manchester), Civil Engineers, 40, Kennedy-street, Manchester, upon deposit of a cheque for Five Guineas.

This sum will be returned to the tenderer provided that he shall have sent in a bona fide Tender and shall not have withdrawn the same, and shall have returned the documents lent to him.

A limited number of sets of drawings (uncoloured) are available and will be lent to persons tendering, in priority of application, on receipt of the sum of Two Guineas, which will not be returned.

Sealed Tenders, endorsed "Goyt Valley Supply, Contract A," and addressed to the "Chairman of the Waterworks Committee," must be delivered at the Waterworks Offices, Town Hall, Stockport, not later than the 6th day of January, 1931.

The Committee do not bind themselves to accept the lowest or any Tender.

ROBERT HYDE,
Town Clerk.
Town Hall, Stockport,
December 5th, 1930. 6206

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PUBLIC NOTICES

Manchester Corporation.

The Rivers Committee invite TENDERS for the CONSTRUCTION of MAIN DRAINAGE WORK No. 14 (New Sewer, Moston-lane, from Work No. 5, Rochdale-road to Blue Bell-avenue, Moston).

Plans may be seen and specifications, bills of quantities and forms of Tender obtained on application at the City Engineer's Office, Town Hall, Manchester, on payment to the City Treasurer of £5 5s., which sum will, after the Corporation have come to a decision upon the Tenders received, but not before, be returned to the person submitting a bona fide Tender.

All cheques or postal orders are to be made payable to the order of "The Corporation of Manchester."

Tenders, enclosed in the official envelope and addressed to the Chairman of the Rivers Committee, are to be delivered at the City Engineer's Office not later than 9.30 a.m. on Tuesday, the 30th December, 1930.

The Corporation do not bind themselves to accept the lowest or any Tender.

F. E. WARBRECK HOWELL,
Town Clerk.

Town Hall, Manchester,
6th December, 1930. 6205

The County of London Electric

SUPPLY COMPANY, LTD.
BARKING POWER STATION EXTENSIONS, 1930.
TENDERS FOR THE SUPPLY OF COAL UNLOADING CRANES.

The County of London Electric Supply Company, Limited, are prepared to receive TENDERS for the SUPPLY and ERECTION of COAL UNLOADING CRANES in connection with extensions to the Power Station at Barking.

Specifications may be obtained by Coal Unloading Crane Manufacturers from the offices of the Company by application on or after Tuesday, 16th December, 1930, and on payment of a fee of £5 5s. for the first copy and £2 2s. for every subsequent copy. Sums paid for any number of copies up to three will be refunded on receipt of a bona fide Tender.

Sealed Tenders, endorsed "Tender for Coal Unloading Cranes," must be delivered, addressed to the CHAIRMAN and MANAGING DIRECTOR, the County of London Electric Supply Company, Ltd., County House, 46/47, New Broad-street, London, E.C. 2, not later than Noon on Monday, 2nd February, 1931.

The Company do not bind themselves to accept the lowest or any Tender. 6198

The County of London Electric

SUPPLY COMPANY, LTD.
BARKING POWER STATION EXTENSIONS, 1930.
TENDERS FOR THE SUPPLY OF COAL-HANDLING PLANT, INCLUDING TRAVELLING BRIDGE AND BELT CONVEYORS.

The County of London Electric Supply Company, Limited, are prepared to receive TENDERS for the SUPPLY and ERECTION of COAL-HANDLING PLANT, including TRAVELLING BRIDGE and BELT CONVEYORS, in connection with extensions to the Power Station at Barking.

Specifications may be obtained by Coal-handling Plant Manufacturers from the offices of the Company by application on or after Tuesday, 16th December, 1930, and on payment of a fee of £5 5s. for the first copy and £2 2s. for every subsequent copy. Sums paid for any number of copies up to three will be refunded on receipt of a bona fide Tender.

Sealed Tenders, endorsed "Tender for Coal-handling Plant, including Travelling Bridge and Belt Conveyors," must be delivered, addressed to the CHAIRMAN and MANAGING DIRECTOR, the County of London Electric Supply Co., Ltd., County House, 46/47, New Broad-street, London, E.C. 2, not later than Noon on Monday, 2nd February, 1931.

The Company do not bind themselves to accept the lowest or any Tender. 6197

Egyptian Government.

APPOINTMENT OF A BOILER INSPECTOR.

APPLICATIONS are INVITED for APPOINTMENT as a BOILER INSPECTOR in the Mechanical Department of the Egyptian State Railways, Telegraphs and Telephones Administration.

Applicants must be of British nationality, between 30 and 40 years of age, and possess the following qualifications :—

Must have served a regular apprenticeship with a railway company or a firm of locomotive builders.

Must be fully qualified to examine and report on the condition of boilers.

Must have had wide experience in the Boiler Building and Repair Work.

Must have had experience in control of men.

In addition to experience in boiler work, experience in the Running Department of a Railway is necessary.

Salary £E480 per annum (£E1 equals £1 0s. 6d. approximately), free of Egyptian income tax.

The appointment is subject to medical examination.

The selected candidate will be granted a transfer allowance equal to one month's salary for change of residence from England to Egypt and vice versa.

Period of contract THREE YEARS, NOT LIABLE TO RENEWAL.

Third-class fares and reasonable out-of-pocket expenses will be paid to applicants who are requested to attend for interview and/or medical examination.

Application and specimen contract forms may be obtained from

THE CHIEF INSPECTING ENGINEER,
Egyptian Government,
41, Tothill-street, London, S.W. 1.

to whom they should be returned, with full particulars as to education, qualifications, previous experience, personal references and COPIES of certificates or testimonials.

Envelopes to be inscribed "BOILER INSPECTOR." 6214

Government of Northern IRELAND.

CIVIL ENGINEERING CLERKS OF WORKS.

APPLICATIONS are INVITED for TWO VACANCIES under the Ministry of Finance for TEMPORARY CIVIL ENGINEERING CLERKS OF WORKS in connection with the Bann Drainage Contract.

APPLICATIONS MUST REACH THE SECRETARY (ESTABLISHMENT DIVISION), MINISTRY OF FINANCE, 15, Donegall-square West, Belfast, NOT LATER THAN THE FIRST POST ON MONDAY, THE 22ND DECEMBER, 1930. They must be on the prescribed form, which, together with particulars of the duties and necessary qualifications, can be obtained from the above address, and should be accompanied by copies of testimonials from persons having direct knowledge of the applicants' capabilities and work. 6207

Wolverhampton Corporation

WATER UNDERTAKING.
ENGINEERING ASSISTANT.

APPLICATIONS are INVITED for the POST of ENGINEERING ASSISTANT at a salary of £210 per annum, rising by annual increments of £10 to £270 per annum, in accordance with the Corporation's Salary Grading Scheme, and subject to percentage deductions in accordance with the Local Government and Other Officers' Superannuation Act, 1922. The selected candidate will be required to pass a medical examination.

Applicants must have had Civil Engineering training. Applications, stating age, qualifications and experience, together with copies of three testimonials, must be delivered to the undersigned on or before the 29th of December, 1930. Envelopes are to be endorsed "Engineering Assistant."

B. L. MCMILLAN,
Water Engineer and Manager.

Town Hall, Wolverhampton,
1st December, 1930. 6169

Gears
See large advertisement next week.
The Power Plant Co. Ltd.
WEST DRAYTON · MIDDLESEX

PUBLIC NOTICES

H.E.H. The Nizam's State RAILWAY BOARD.

REQUIRED for SERVICE in India with the above Railway :—

2 DISTRICT LOCOMOTIVE SUPERINTENDENTS.

Candidates must have had good experience as Mechanical and Locomotive Engineers and have held responsible posts in the Running Department of a railway. They must possess a sound knowledge of Applied Mechanics and of the work done and materials used in Railway Workshops. Candidates with Indian or Colonial experience would be preferred. Applications will be considered from candidates of 35 to 40 years of age.

SALARY.—Rupees 1100 per calendar month, rising by annual increments of Rs. 50 to Rs. 1500 a month. The Board would, however, be prepared to consider a starting pay at any figure within this grade, according to the age and qualifications of the officers selected.

TERMS.—A five years' agreement in the first instance, and first-class free passage to India. The selected candidates will be required to pass a strict medical examination by the Board's Consulting Physician before being actually appointed.

Applications (by letter only), giving candidate's age, whether married or single, details of general and technical education, degrees (if any), training and subsequent experience, in chronological order, with dates, accompanied by copies of testimonials, &c., should be addressed to the undersigned not later than 30th December, 1930.

F. ADAMS,
Secretary.

Winchester House,
100, Old Broad-street,
London, E.C. 2,
10th December, 1930. 6225

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED by Firm of Engineers' Merchants, a REPRESENTATIVE. Excellent salary and position offered to applicant who would be willing to invest up to £2000 in business.—Address, 6231, The Engineer Office. 6231 A

WANTED, Good Live Man to Act as MANAGER to a Pump Business.—Address, stating age, experience and salary required, 6228, The Engineer Office. 6228 A

MANUFACTURERS of Underground Conveyors REQUIRE SKILLED DRAUGHTSMAN, not over 25 years. Must have good Mathematical and Constructor's ability. Able to work out own jobs. State qualifications and salary required.—Address, 6230, The Engineer Office. 6230 A

PRODUCTION ENGINEER REQUIRED in Factory manufacturing Switchgear of all kinds. Good electrical knowledge is necessary. Applicants should state salary required and give full particulars of experience.—Address, 6192, The Engineer Office. 6192 A

REQUIRED, a YOUNG ENGINEER, Versatile and restless, experience in Boiler Design and Steam Engines, to Take Charge of Development Work and Drawing-office of well-known firm of Boilermakers.

Give age and full particulars of past experience.

Box 141, Brown's, 39, Tothill-street, S.W. 1. 6222 A

THE BRITISH BROADCASTING CORPORATION REQUIRE the SERVICES of a competent ELECTRICAL ENGINEER, experienced in the Handling of Contracts and Supervision of Installation of New Plant. Some Wireless knowledge an advantage, but not essential. Commencing salary about £400. —Application by letter only, stating full particulars of qualifications and experience, to CHIEF ENGINEER, B.B.C., Savoy-hill, W.C. 2. 6223 A

JUST PURCHASED

10 5-TON STEAM LOCO CRANES

by

SMITH, RODLEY

NEW - 1925-6.

All standard gauge, Jibs 35 ft., 100 lbs. pressure, lying in the North of England.

Particulars and prices on application to:—

GEORGE COHEN, SONS & CO., LTD.

600, COMMERCIAL ROAD EAST - LONDON, E.14,

OR

Stanningley Works, Stanningley, LEEDS.

TELEGRAMS: "COBORN, LONDON." "COBORN, LEEDS."

SITUATIONS OPEN (continued)

GOOD MECHANICAL DRAUGHTSMAN REQUIRED, used to Hydraulic and Heavy Machinery.—Apply by letter, stating experience, age and salary required, to WELLMAN SEAVER ROLLING MILL COMPANY, Limited, Victoria Station House, Victoria-street, S.W. 1. 6217 A

JUNIOR CONSTRUCTIONAL STEELWORK DRAUGHTSMAN for London Consulting Engineer's Office. State experience and salary expected.
Address :
P587, The Engineer Office. P587 A

FOREMAN for Foundry Making Brass, Gun-metal and Aluminium, WANTED IMMEDIATELY. Previous experience essential.—Apply by letter to ENGLISH ELECTRIC COMPANY, Ltd., Stafford. 6174 A

SITUATIONS WANTED

ADVERTISER, A.M.I.E.E., Age 28, DESIRES POSITION with good prospects, home or abroad. Extensive electrical and mechanical experience, technical and commercial, in England and overseas; technical college diploma and works training with leading firm of electrical manufacturers; excellent credentials.—Address, P591, The Engineer Office. P591 B

AGRICULTURE.—ENGINEER REQUIRES POSITION; fully experienced design, production and sale of tractors at home and abroad.—Address, P569, The Engineer Office. P569 B

CONTRACTOR'S ENGINEER (32), 11 Years' Exp. with famous firms on construction of large works, home and abroad, in very responsible capacity, SEEKS EXPERIENCE with Civil Engineering Firm where knowledge of costs and contractors' methods may be of use.—Address, P596, The Engineer Office. P596 B

COST and WORKS ACCOUNTANT, Experienced in works administration in large manufacturing concern, OPEN for ENGAGEMENT. Can organise and take control.—Address, P602, The Engineer Office. P602 B

ELECTRICAL MAINTENANCE ENGINEER SEEKS SITUATION; good references.
T. GILLMAN, 158, Maryland-road, Stratford, E. 15. P585 B

ENGINEER, A.M.I. Mech. E., Experienced GENERAL MANAGER, home and abroad (India and Brazil), recently returned from Brazil, is OPEN for ENGAGEMENT. Wide experience and accustomed to full control all departments, works and administration; also handling agencies. Excellent record and highest references.—Address, P566, The Engineer Office. P566 B

ENGINEER WORKS MANAGER (36), with Experience of modern methods for the production of light engineering products, mechanical and electrical, capable organiser, used to mixed labour, DESIRES CHANGE. Moderate salary.—Address, P570, The Engineer Office. P570 B

GENERAL MANAGER OR MANAGING DIRECTOR.—ENGINEER of long, varied and exceptional experience SEEKS MANAGEMENT, SUPERVISION or DIRECTION of INDUSTRIAL UNDERTAKING, or would accept Post as Permanent Resident Engineer.

Experience comprises : Sea, port and river works, narrow gauge and temporary railways, quarries, mines, waterworks, drainage, repair shops, concrete and heavy masonry, building construction, aerial ropeways, inclines, &c.

Address, P589, The Engineer Office. P589 B

STRUCTURAL ENGINEER, Theoretical and Practical, 20 yrs.' experience home and abroad, steel construction of every description, REQUIRES APPOINTMENT as Superintendent or Representative. —Address, P601, The Engineer Office. P601 B

SITUATIONS WANTED (continued)

HEATING and HYDRAULIC ENGINEER, Specialist in water softening plants and defective heating installations, filtration schemes by gravity or pressure, deep well and ram pump supplies, &c., SEEKS APPOINTMENT where abilities may have adequate scope.—Address, P592, The Engineer Office. P592 B

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The Gyro Compass.

BY an award made by Mr. Justice Luxmoor in the Chancery Division last week, the gyro-compass patents held by Mr. S. G. Brown have been extended for ten years, the maximum period of extension permitted by the Patents Act. Of the two patents involved one was taken out in 1914 and the other in 1916, both being in the joint names of Mr. S. G Brown and the late Professor John Perry.. The second patent was made secret by the Admiralty and was not published until 1919. Because of the control exercised by the Government, Mr. Brown was prevented from selling his compasses until 1920. Between 1923 and 1926, Mr. Brown was engaged in litigation with the Sperry Gyroscope Company. His patent was held to be valid, but it was also held that the Sperry compass did not infringe the Brown and Perry patents. The litigation involved a loss to Mr. Brown of £23,000. In addition, loss on the manufacture and sale of the compass amounted to £18,274. In 1928 the sales amounted to £10,839, and in 1929 to £15,782. Over ten years the sales produced a sum of £57,842. Inadequate remuneration was the ground on which Mr. Brown claimed an extension of his patents. On behalf of the Controller of Patents, it was urged that an extension of five years would be adequate. The judge, however, did not agree. The invention, he said, was of exceptional merit and of exceptional benefit to the public. The loss sustained by the patentee was not likely to be wiped out, and an adequate remuneration for his skill received unless the term was extended for a considerable time. The first patent having expired would, he said, be re-granted for a period of ten years. The second, which would not expire until August, 1932, would be extended for a similar length of time.

Oil Electric Traction.

SPEAKING at a recent meeting of the Institute of Transport, Mr. E. J. H. Trutch, of the Diesel Electric Traction Department of Sir W. G. Armstrong Whitworth and Co., contended that the railway companies would derive many advantages from the adoption of the oil electric engine in place of the steam locomotive. The annual savings in the cost of maintenance, fuel, wages and water would amount to at least £19,250,000. Whilst the colliery companies might raise some outcry against the importation of oil to take the place of home produced coal, it was to be remembered that the coal used by the railways represented but a small proportion of the total tonnage raised and the reduction of freight rates made possible by the reduced operating expenses might be of greater value to the collieries than the lost railway purchases. In any case, the time was not far distant when sufficient oil would be produced from home-mined coal. If traffic permitted, there was nothing to prevent the oil-electric unit running 24 hours a day for six days a week and, if necessary, for 13 days out of 14 with no attention other than oiling and superficial examination of the running gear. Its time in service was, in fact, only bounded by periodical maintenance inspections, and it was ready for service upon the pressing of the electric starting switch. As the oil-electric engine had a control cab at each end, it required no turntable or turning time and consequent occupation of running lines at terminals. Any railway system constituted on the lines of the big groups in Great Britain could replace, on the average, approximately two steam locomotives by one oil-electric unit of equivalent power, assuming all motive power to be replaced. The daily "hostlering" required by the steam locomotive and the labour required in preparing the engine and raising steam would give place to weekly or fortnightly maintenance inspections.

The R 101 Inquiry.

THE public inquiry which Sir John Simon has been holding into the loss of the airship "R 101" was brought to a close last Friday, December 5th. Of the resumed sittings, that held on the 4th was of great interest, for at it Dr. Hugo Eckener, designer and pilot of the "Graf Zepplein," gave what he believed to be the explanation of the cause of the disaster. According to Dr. Eckener's view, we are to suppose that as the result of gas leakage from the bags the airship was about 4 tons too heavy; that is to say, the buoyancy derived from her gas was that amount less than her total weight. The deficiency required to sustain the vessel in the air was being made good by flying the vessel with her nose slightly up. She was, in other words, being sustained in the air precisely in the manner of an aeroplane, namely, by the aerodynamic lift derived from her forward speed. At 2 a.m. the coxswain, who had been in charge of the elevators since the start of the voyage, was relieved. It is suggested by Dr. Eckener that the new coxswain did not immediately realise that the ship was heavy at the nose as a result of the gas leakage, and that at first he might mistake the dropping of the nose for a "bump." Expecting the effect of the bump to pass away, he would not immediately correct the dip by putting the elevators further up. Actually, the downward tilt would cause the escaping gas to pass between the gas bags and the outer fabric to the stern end, and thereby to increase the tilt. The airship would thereupon assume a steep diving angle, a severe and sudden stress would be thrown on the gas bags which had already been chafed and punctured, and the bags would split and allow a large quantity of gas to escape suddenly. Efforts would no doubt be made to restore the vessel to the horizontal by putting the elevators full up, and by discharging ballast forward. In the course of these manœuvres, the vessel would loose forward speed. It might possibly fall to as low as 4 or 5 miles an hour. As a consequence, the aerodynamic lift on which the airship had been depending would fall almost to zero. That the vessel could not avoid coming to the ground would be realised by those in control, who would, as a last chance, release all the forward ballast and stop the engines in order to lessen the inevitable impact.

Reorganising the Coal Mines.

UNDER the Coal Mines Act, 1930, a Coal Mines Reorganisation Commission was brought into being. The duties of this body are defined by the Act as consisting of the promotion and assistance, by the preparation of schemes and otherwise, of the amalgamation of undertakings consisting of or comprising coal mines, where such amalgamations appear to the Commission to be in the national interest. The Commission is authorised to hold inquiries and employ technical agents. It has power to require owners to submit amalgamation or absorption schemes, and if they fail it may itself prepare schemes and submit them for sanction by the Railway and Canal Commission. The members of the Commission must not be members of the House of Commons, and within three months of their appointment must dispose of any interests they may have in coal mines. The names of the appointed Commissioners were announced this week. The Chairman is Sir E. A. Gowers, who will vacate his present position as Chairman of the Board of Inland Revenue in order to devote his whole time to the work of the Commission. The other members of the Commission are.—Mr. L. D. Holt, the shipowner and last year's Lord Mayor of Liverpool; Mr. Joseph Jones, general secretary of the Yorkshire Mine Workers' Association; Sir Felix Pole, formerly general manager of the Great Western Railway, and now chairman of Associated Electrical Industries, Ltd.; and Sir W. E. Whyte, a former President of the Royal Sanitary Association of Scotland.

The United States Navy.

ON Monday, December 8th, the United States Secretary of the Navy laid before Congress the naval programme for the next financial year. The total expenditure for which authorisation was sought was £32,000,000. Of that sum, £6,000,000 is assigned to the modernisation of the battleships "New Mexico," "Mississippi," and "Idaho." The remainder is earmarked for new construction. The sum of £4,150,000 is allocated to the construction of a 10,000-ton 6in. gun cruiser, fitted with a deck permitting it to carry twenty-five to forty aeroplanes. An experimental 7500-ton cruiser fitted with 6in. guns is to cost £3,200,000. Eleven destroyers costing £9,400,000, four submarines costing £3,500,000, and one aeroplane carrier costing £5,530,000, are also included in the programme. Of the eleven destroyers, one is to be a flotilla leader of 1850 tons, costing £1,000,000, and the rest are to be vessels of 1500 tons. The aeroplane carrier is to be of 13,800 tons, and although it will be much smaller than the "Lexington" and "Saratoga," it will be capable of carrying 114 machines. The Budget for 1932 is also to include £200,000 to meet part of the expenditure on the second of two large airships, the total cost of both being £1,600,000. These airships are presumably the two 6½-million cubic feet helium-filled vessels of which the first is now well in hand at Akron. They will carry a considerable armament of guns, and will be fitted to accommodate aeroplanes within their structure for release in the air. A feature of their power equipment will consist in the arrangement provided to swivel the propellers.

Loss of the Salvage Vessel Artiglio.

SALVAGE engineers throughout the world will have learned with profound regret of the severe loss Italy has suffered by the sudden foundering of the salvage vessel "Artiglio," involving the death of twelve of her crew. Among those who were lost is numbered the captain of the ship, Bertholotto, and the three divers Gianni, Franceschi and Bargellini, who recently performed astounding feats of deep-sea diving when locating the wreck of the P. and O. liner "Egypt." At the time of the accident the "Artiglio" was engaged in demolishing the wreck of the steamer "Florence," a munitions ship which was sunk during the war in the channel near Quiberon, between the islands of Belle Ile and Houat. The salvage engineers had placed in position certain explosive charges and the ship had steamed a small distance away before the charges were fired by an electric current. It is assumed that the explosion ignited a very large quantity of explosive material which was in the ship's holds, for the wave which followed the explosion was such as completely to engulf the "Artiglio" at a distance of 200 yards from the "Florence." The "Artiglio" was built by Mackie and Thomson in 1906 and served as a mine-sweeper in the Royal Navy under the name "Macbeth." She was a ship of 284 tons gross and was completely equipped for salvage work by her owners, the "Sorima" Company (Società Ricuperi Maritime), of Genoa.

The Late Mr. John R. Sutherland.

BY the death of Mr. John R. Sutherland, which occurred on Saturday last, December 6th, at Largs, the Corporation of Glasgow has lost one of its most faithful and skilled engineers. Mr. Sutherland, who retired from the position of manager of the Water Department in 1926 after service with the municipality extending over thirty-seven years, was a Glasgow man. He was educated at Glasgow High School and the University of Glasgow, and received his early training as a civil engineer with Messrs. Smith and Wharrie, later Messrs. Wharrie and Colledge, and also, after some railway service, with Messrs. Kyle, Dennison and Frew. Entering the Water Department as a civil engineer in 1889, he received regular promotion and became assistant engineer in 1892 and chief engineer in 1903. In 1920 he was appointed the manager of the Water Department, a position which he held with distinction until 1926, when he retired under the age limit. Some of Mr. Sutherland's first work was connected with the new filters and pipe lines for the waterwroks at Gorbals, nearly thirty years ago. At a later date he had much to do with the repairing and the re-lining of the Loch Katrine aqueduct, the construction of the dam at Loch Arklet, and the duplication of the mains from the Craigmaddie Reservoir at Milngavie. Mr. Sutherland was also responsible for the raising of the level of Loch Katrine, and he was associated with the drawing up of the scheme for obtaining a supply of water from Loch Voil and Loch Doune, which scheme was rejected by an appeal to Parliament. He supervised most of the later development work connected with the department, leaving on his retirement well-planned arrangements for adding to the existing supplies of water, should the city require them in the future.

Salvage Operations at Scapa Flow.

ON Sunday last, December 7th, the 20,000-ton ex-German battle-cruiser "Von der Tann," which was sunk in Scapa Flow upside down in 13 fathoms of water, was successfully refloated upside down by Cox and Danks, Ltd. After being brought to the surface in a comparatively level condition, the hull was towed a distance of 200ft. into water some 20ft. shallower. It is intended to beach it in Mill Bay, close to the depôt of the firm at Lyness Pier. The vessel has been brought to the surface in the record time of three months. Work was begun on her early in September, but it has often been delayed by bad weather. The upturned hull was pierced and air locks were attached to it, enabling the water to be forced down in the machinery spaces by means of compressed air. In the final stages of the refloating operation great care had to be taken so to balance the lifting and the righting forces that the ship did not, under low-tide conditions, suddenly rise at the bow. Much of the later work had, in fact, to be carried out at high tide only. We are glad to state that the members of Mr. Cox's salvage staff who were injured in the recent explosion which took place inside the ship are all making good progress. The men were cutting through a scupper pipe with an oxy-acetylene flame when an explosion of gas within the pipe occurred. Happily the damage done was such that any danger of flooding was avoided. With the salving of the "Von der Tann" the firm has raised ships in Scapa Flow corresponding to a total of 150,000 tons displacement.

Problems of Ship Design.

SOME interesting and important considerations relating to the design of efficient ships were discussed in a paper which was read before the Institute of Marine Engineers on Tuesday evening last by Dr. J. Tutin and Mr. A. C. Hardy. The authors put forward the view that it lies in the power of the shipbuilder to stimulate orders for new tonnage by the design of super-efficient ships. The operating costs of a tramp ship were examined, as also was the performance of the propelling machinery. The possible improvements outlined in the paper included modifications in hull form, the re-designing of propellers and a fresh consideration of their best position in relation to the hull, the finding of a possible remedy for sea-sickness, including the automatic stabilisation of ships, and improvements in passenger accommodation. The idea that what was needed was an organisation which, by research, experiment and invention, will effect a comprehensive improvement in ship design by the cumulative effect of detailed improvements, follows the recent plea of Mr. John de Meo, for a reconsideration of the whole problem of ship propulsion and the co-ordination of the technical interests in each country in order to bring about this very desirable end. Mr. de Meo's proposal that future ships should be propelled by small screws at the centre of the hull, either in pockets at the sides or below the ship's bottom, was favourably referred to at the meeting.

The Heating and Drying of Granular Materials by Convection.

By W. GILBERT, Wh. Sc., M. Inst. C.E.

No. VI. (*conclusion*).*

CALCULATIONS RELATING TO THICK LAYER DRYERS WITH CONTINUOUS FEED.

THE experiments which have been made, and the formulæ developed in connection with them, can now be applied to elucidate the working of various forms of dryers which are, or may be, used in practice. Layer dryers will be first considered.

Case I.: Parallel Flow Thick Layer Dryer.—A diagram illustrating the action of the dryer is given by Fig. 29. The apparatus is assumed to consist of a pipe or conduit of 1 square foot in cross section, the coal is fed in at a uniform rate at the lower level A A and discharged at a uniform rate at the upper level B B. The hot air enters the coal at the level A A, flows in the same direction, and is discharged at the level B B. The inlet and exit air temperatures are decided in the first instance. It is required to calculate the air temperature fall and the coal temperature rise at any distance L from the inlet section A A, also the total thickness of coal layer L_t, which is necessary to give the required temperature fall to the air, and the required temperature rise to the coal.

The two essential formulæ are obtained by the use of differential equations from the following fundamental statement, which relates to drying after steady conditions have been reached :—

$$H_c \times (\Sigma\, c\,S \times T\,d) = a\,W \times a\,\varphi \times a\,T\,f = c\,W \times c\,\varphi\,e \times c\,T\,r \quad . \quad . \quad (10)$$

The first expression is the quantity of heat supplied to the coal per hour by convection, $c\,S$ denotes the surface area of any particle of coal, and $T\,d$ the corresponding temperature difference between the hot air in contact with the particle at any instant, and the surface temperature of the particle.

The second expression gives the quantity of heat released by the air per hour ; $a\,W$ is the air weight per hour, per square foot of cross section, $a\,\varphi$ the air specific heat, and $a\,T\,f$ the constant temperature range through which the air is supposed to fall.

The third expression states the heat received by the coal per hour per square foot of cross section, as measured by its weight, its equivalent specific heat, and its rise of temperature.

The notation used is as follows :—

$a\,T\,i$ = air temperature at inlet ;
$a\,T\,e$ = air temperature at exit ;
$a\,T\,f$ = air temperature fall ;
$c\,T\,i$ = coal temperature at inlet ;
$c\,T\,e$ = coal temperature at exit ;
$c\,T\,r$ = coal temperature rise ;
$a\,W$ = air weight per hour per square foot of cross section ;
$c\,W$ = coal weight per hour per square foot of cross section ;
$a\,\varphi$ = air specific heat ;
$c\,\varphi\,e$ = equivalent coal specific heat, which includes evaporation ;
$c\,S\,c\,f$ = coal surface in square feet per cubic foot ;
H_c = convection constant.

Weights are in pounds and dimensions in feet.

Time is in minutes, except that the values of $a\,W$, $c\,W$, and H_c are expressed in hour units, as is customary.

The formulæ are as follows :—

$$a\,T\,f = \frac{N}{M+N}\,(a\,T\,i - c\,T\,i)\,(1 - e^{-Q\,L}) \quad . \quad . \quad (11)$$

$$L_t = \frac{2 \cdot 303}{Q} \log \frac{a\,T\,i - c\,T\,i}{a\,T\,e - c\,T\,e} \quad . \quad . \quad . \quad . \quad (12)$$

In the foregoing formulæ :—

$$Q = \frac{N+M}{N} \times \frac{\overline{H}\,\overline{K}}{M\,(\overline{H}+\overline{K})} \qquad M = \frac{a\,W \times a\,\varphi}{60}$$

$$N = \frac{c\,W \times c\,\varphi\,e}{60} \qquad \overline{H} = \frac{H_c \times c\,S\,c\,f}{60} \qquad \overline{K} = \frac{K \times c\,S\,c\,f}{60\,\bar{x}}$$

From the fundamental statement numbered (10), we also have

$$a\,W \times a\,\varphi \times a\,T\,f = c\,W \times c\,\varphi\,e \times c\,T\,r$$

$$\therefore\ c\,W = \frac{a\,W \times a\,\varphi \times a\,T\,f}{c\,\varphi\,e \times c\,T\,r} \quad . \quad . \quad . \quad (13)$$

Numerical Example for Parallel Flow.—Suppose that H coal, grade V., is being dried, the value of $a\,W$ being 940. The initial hot air temperature $a\,T\,i$ may be taken at 700 deg. Fah., since it comes first into contact with the damp coal. It is assumed from the data given on the various graphs that when the average temperature of the coal has reached 300 deg. Fah., it will be approximately 95 per cent. dry, so that $c\,T\,e$ is taken at this figure.

Since the dryer is of the parallel flow type, the exit air temperature must be above the exit coal temperature; hence $a\,T\,e$ is put 330 deg. Fah. and $a\,T\,f = (700-330) = 370$ deg.

Taking $c\,T\,i = 60$ deg., we get $c\,T\,r = 300-60 = 240$ deg. Fah.

The coal moisture is 15·55 per cent., and the coal equivalent specific heat, as previously calculated = 1·16. Also let $H_c = 22 \cdot 3$, $c\,S\,c\,f = 94 \cdot 32$, $\bar{x}$ for grade V. coal = 0·05in., and K = 1·42—see Table IX., November 28th, noting that graded coal weighs 36 lb. per cubic foot.

From formula (13) we obtain the weight of coal dried per square foot per hour

$$c\,W = \frac{940 \times 0 \cdot 24 \times 370}{1 \cdot 16 \times 240} = 300 \text{ lb.}$$

The component parts of formula (11) are next calculated

$$M = \frac{940 \times 0 \cdot 24}{60} = 3 \cdot 76 \qquad N = \frac{300 \times 1 \cdot 16}{60} = 5 \cdot 80$$

$$\overline{H} = \frac{22 \cdot 3 \times 94 \cdot 32}{60} = 35 \cdot 0 \qquad \overline{K} = \frac{1 \cdot 42 \times 94 \cdot 32}{60 \times 0 \cdot 05} = 44 \cdot 6$$

and

$$Q = \frac{9 \cdot 56}{5 \cdot 80} \times \frac{35 \times 44 \cdot 6}{3 \cdot 76 \times 79 \cdot 6} = 8 \cdot 6$$

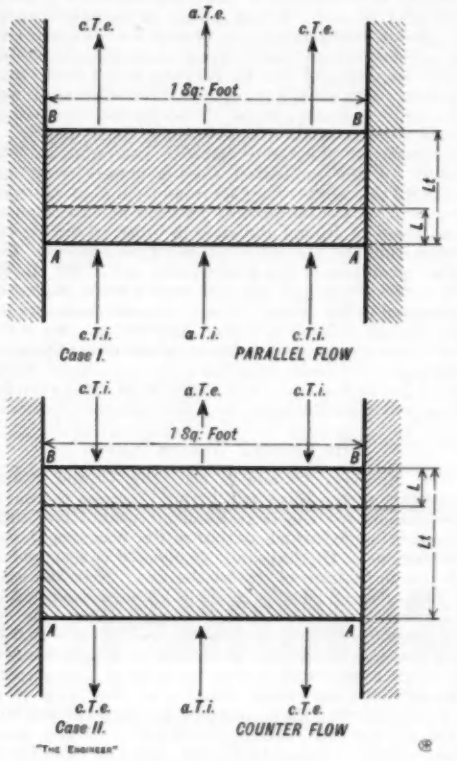
To calculate the total thickness of the layer L_t we have from (12)

$$L_t = \frac{2 \cdot 303}{8 \cdot 6} \log \frac{700-60}{330-300} = \frac{2 \cdot 303 \times 1 \cdot 3291}{8 \cdot 6} = 0 \cdot 356 \text{ft.}$$

That is, $L_t = 4 \cdot 27$in.

The small depth of layer which is required to perform the drying is rather an unexpected result. At first sight, a much greater distance would seem to be necessary.

To find the air temperature fall at any distance



FIGS. 29 AND 30

L from A A—Fig. 29—where L is measured in feet, we obtain by substituting in formula (11)

$$a\,T\,f = \frac{5 \cdot 80 \times 640}{9 \cdot 56}\,(1 - e^{-8 \cdot 6\,L})$$

If L = 1in. = $^1/_{12}$ft., we have

$$a\,T\,f = 388\,(1 - e^{-0 \cdot 7167})$$

Put $y = e^{0 \cdot 7167}$, then $\log y = 0 \cdot 7167 \times 0 \cdot 4343 = 0 \cdot 311$, and from a table of logarithms—

$$y = 2 \cdot 046\ ;\ \text{hence } e^{-0 \cdot 7167} = \frac{1}{2 \cdot 046}$$

and

$$a\,T\,f = \frac{388 \times 1 \cdot 046}{2 \cdot 046} = 198 \text{ deg. Fah.}$$

The corresponding rise in the coal temperature is found from formulæ (13), thus

$$C\,T\,r = \frac{a\,W \times a\,\varphi \times a\,T\,f}{c\,W \times c\,\varphi\,e} = \frac{940 \times 0 \cdot 24 \times 198}{300 \times 1 \cdot 16} = 128 \text{ deg. Fah.}$$

Proceeding in the above manner, values of $a\,T\,f$ and $c\,T\,r$ can be calculated for L = 2in., 3in., 4in. The result is shown by the graph (A *i*).

Case II.: Counter Flow Thick Layer Dryer.—A diagram of the arrangement is shown by Fig. 30. The hot air enters at section A A as before, and is discharged at section B B. The coal enters at a uniform rate at section B B, and is discharged at section A A.

The required formulæ are :

$$a\,T\,f = (a\,T\,i - c\,T\,i) + \frac{a\,T\,e - c\,T\,i}{N-M} \times (M - N\,e^{V\,L}) \quad (14)$$

$$L_t = \frac{2 \cdot 303}{V} \log \frac{a\,T\,i - c\,T\,e}{a\,T\,e - c\,T\,i} \quad . \quad . \quad . \quad . \quad (15)$$

(L is measured from the coal inlet end B B.)

M, N, $\overline{H}$ and $\overline{K}$ have the same meaning as for case I., but Q is replaced by V, where

$$V = \frac{N-M}{N} \quad \frac{\overline{H}\,\overline{K}}{M\,(\overline{H}+\overline{K})}$$

A numerical example is worked out, using the preliminary data, as before :—H. coal, grade V. $a\,W = 940$, $H_c = 22 \cdot 3$, $c\,\varphi\,e = 1 \cdot 16$, $c\,S\,c\,f = 94 \cdot 32$. The values of M, $\overline{H}$ and $\overline{K}$ remain as for case I. In counter-flow, the hot air comes first into contact with the dried coal ; hence $a\,T\,i$ is taken at the lower value of 500 deg. Fah. The value of $a\,T\,e$ must be high enough to prevent the deposition of moisture in the exhaust piping ; 150 deg. is usually suitable, hence air temperature range = 500 deg. to 150 deg. Fah. and $a\,T\,f = 350$ deg. Coal temperature range 60 deg. to 300 deg. Fah., and $c\,T\,r = 240$ deg.

From formula (13) the coal dried per square foot per hour is now

$$C\,W = \frac{940 \times 0 \cdot 24 \times 350}{1 \cdot 16 \times 240} = 284 \text{ lb.}$$

Hence

$$N = \frac{C\,W \times c\,\varphi\,e}{60} = \frac{284 \times 1 \cdot 16}{60} = 5 \cdot 48,$$

and

$$V = \frac{5 \cdot 48 - 3 \cdot 76}{5 \cdot 48} \times \frac{35 \cdot 0 \times 44 \cdot 6}{3 \cdot 76 \times 79 \cdot 6} = 1 \cdot 637$$

The total thickness required for the layer, from (15) is :

$$L_t = \frac{2 \cdot 303}{1 \cdot 637} \log \frac{500-300}{150-60} = \frac{2 \cdot 303 \times 0 \cdot 3468}{1 \cdot 637} = 0 \cdot 489 \text{ft.}$$

That is, L = 5·86in.

We may next calculate the hot air temperature fall when L = 1in. = $^1/_{12}$ft.

We have from (14)

$$a\,T\,f = (500-60) + \frac{150-60}{5 \cdot 48 - 3 \cdot 76}\left(3 \cdot 76 - 5 \cdot 48\,e^{1 \cdot 637 \times \frac{1}{12}}\right)$$

$$\therefore\ a\,T\,f = 440 + \frac{90}{1 \cdot 72}\,(3 \cdot 76 - 5 \cdot 48\,e^{0 \cdot 1364})$$

Proceeding as before, it will be found that $e^{0 \cdot 1364} = 1 \cdot 147$.

Hence

$$a\,T\,f = 440 + \frac{90}{1 \cdot 72}\,(3 \cdot 76 - 6 \cdot 28)$$

$$= 440 - \frac{90 \times 2 \cdot 52}{1 \cdot 72} = 308 \text{ deg.}$$

The initial hot air temperature is 500 deg.; hence the air temperature at 1in. from B B—Fig. 30—is 500 − 308 = 192 deg. Fah. See also graph A *j*, Fig. 33.

Since the air temperature at B B = $a\,T\,e$ = 150 deg. Fah., the air temperature fall in the 1in. thickness nearest B B = 42 deg. Fah.

The rise of the coal temperature in the same distance is from (13) :

$$c\,T\,r = \frac{940 \times 0 \cdot 24 \times 42}{284 \times 1 \cdot 16} = 28 \cdot 7 \text{ deg.}$$

hence the actual coal temperature is 88·7 deg. Fah.

The complete result of the numerical example is shown on graph A *j*.

The results of the preceding calculations, and some others, are gathered together in Table XII.

TABLE XII.—*Layer Dryers for Coal.*

Line number.	Type of layer dryer.	Grade of coal used.	Air weight per sq. ft. per hour, lb., $a\,W$.	Coal dried per sq. ft. per hour, lb., $c\,W$.	Air temperature, range, deg. F.	Coal temperature, range, deg. F.	Convection constant, H_c.	Coal surface in sq. ft. per cu. ft. $c\,S\,c\,f$.	Calculative thickness of coal layer, inches L_t.	Value of $\bar{x}$ used, inches.
1	Parallel flow	V.	940	300	700–330	60–300	22·3	94·32	4·27	0·05
2	„	V.	940	461	900–330	60–300	22·3	94·32	5·40	0·05
3	„	V.	376	120	700–330	60–300	8·72	94·32	3·19	0·05
4	„	VII.	658	210	700–330	60–300	11·30	177	2·13	0·027
5	Counter flow	V.	940	284	500–150	60–300	22·30	94·32	5·86	0 05
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)

NOTE.—In all cases coal moisture = 15·55 per cent., K = 1·42, $c\,\varphi\,e = 1 \cdot 16$.

Values of $a\,W$ and H_c, suitable for grades V. and VII. coal, are taken from Table IX.

It has been shown previously that when drying coal containing 15·5 per cent. of moisture, the value of the equivalent specific heat may be taken as 1·16.

The output of a dryer of any size can be obtained from Col. (5). Graded coal of the class used for these experiments, as previously mentioned, was found to weigh 36 lb. per cubic foot, and the surface area for each grade in square feet per pound can be taken from Table IX. The figures given in Col. (9) of Table XII. were thus obtained.

The value of $\bar{x}$ used is that calculated from formula (7)—December 5th.

* No. V. appeared December 5th.

During the drying of the coal the hot air temperature applied to any lump changes continually, so that the conditions under which values of $\bar{x}$ were obtained from the Fourier graphs are not reproduced. But from a consideration of the factors involved, it is not probable that the value of $\bar{x}$ is greater than that assumed. It might, possibly, be from 10 to 15 per cent. less. Referring again to the experiment shown in line (1) of Table XII., suppose the value of $\bar{x}$ is reduced by 20 per cent., thus becoming 0·04, the other

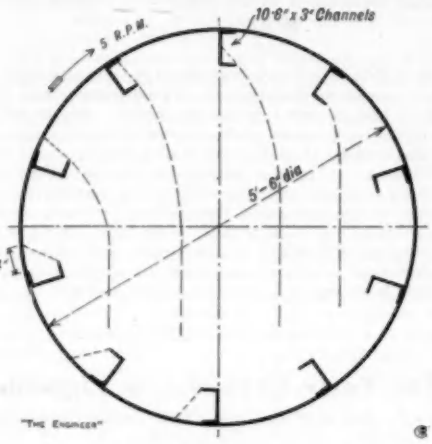


FIG. 31—SINGLE-SHELL ROTARY DRYER

conditions remaining unchanged. On working out the layer thickness, its value is found to be 3·89in., instead of 4·27in., or a reduction of 9 per cent.

The figures obtained show that a very compact dryer may be built on the lines indicated, for coal, limestone, &c., provided that the lump size is not much below grade VIII., or approximately ¼in. × ¼in. × $\frac{1}{16}$in.

There would probably be an improvement in the rate of heat transmission, in the case of the smaller grades of coal, if the particles were kept in a continual state of movement during the drying process, as is done in some types of layer dryers in practice; but this matter has not so far been explored by the writer.

When considering the maximum output which may be obtained from a layer dryer, attention will naturally be given to the water gauge required, and undue escape of dust must be prevented. The

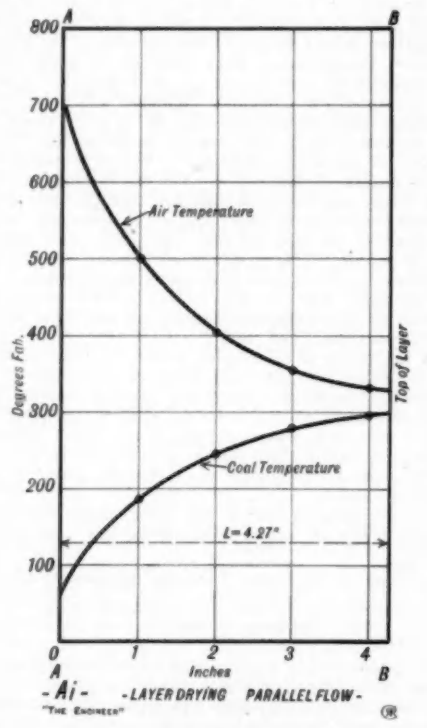


FIG. 32

latter condition may, perhaps, be best met by a counterflow dryer, since the escaping air passes through a layer of damp coal.

If the thickness of the layer can be kept down in practice to something like the dimension found to be theoretically necessary, the water gauge required will usually be small.

SINGLE SHELL ROTARY DRYER.

The formulæ developed for layer dryers may usefully be applied to a single shell rotary dryer, operating on either the parallel flow or the counterflow system.

A typical cross section of the dryer shell is shown in Fig. 31. It is assumed to be 5ft. 6in. in diameter, and to rotate at 5 r.p.m. The material to be dried is lifted and cascaded by ten channels, which are 6in. by 3in. in cross section. The hot gases flow through the inside of the shell only. Owing to a small inclination of the dryer shell and to its rotation, the material slowly passes through it. The number of times a lump has to be cascaded before drying is complete depends on its size and on the initial moisture.

Load in Channels.—Suppose the coal piled 4in. above the channel flange, near the shell—see Fig. 31—the area of the channel load in cross section will be found to be 26·4 square inches. The weight of graded coal being 36 lb. per cubic foot, the coal load per channel per foot run is

$$\frac{26\cdot4\times36}{144}=6\cdot6 \text{ lb.}$$

Since 50 channels are tipped per minute, the weight of coal cascaded per foot run is

$$50\times6\cdot6=330 \text{ lb.}$$

Fall of Coal in Dryer.—The average distance through which the coal falls during cascading is assumed to be 4ft. 6in.; hence the time of fall is

$$t=\sqrt{\frac{2\times h}{g}}=\sqrt{\frac{2\times4\cdot5}{32\cdot2}}=0\cdot53 \text{ second}$$

It follows that during each minute per foot run 330 lb. of coal are exposed to the hot gases for a period of 0·53 second only.

Suppose that grade V. coal is being dried, the surface in square feet per pound is 2·62.

The equivalent coal surface per foot run of channels,

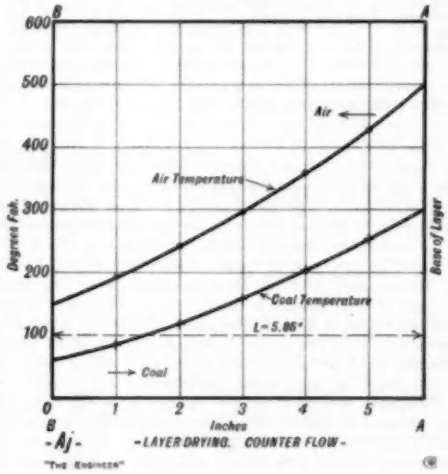


FIG. 33

supposing the particles to be continuously exposed to the hot gases, instead of only for 0·53 second, during each minute, is

$$\frac{330\times2\cdot62\times0\cdot53}{60}=7\cdot65 \text{ square feet}$$

Now, since the dryer is 5ft. 6in. in diameter, the area in cross section for the passage of the hot gases is 23·8 square feet; hence the equivalent coal surface, fully exposed, per square foot of cross section is

$$\frac{7\cdot65}{23\cdot8}=0\cdot322 \text{ square foot per foot run}$$

This compares with a surface of 94·32 square feet per foot run for similar coal, in the case of the thick layer dryer, but the same formulæ apply.

Value of W.—Since the particles are fully exposed, a value of W=1600 may be used, provided that suitable arrangements are made to recover any dust that is carried out of the dryer. There is an increased drying effect owing to the velocity with which the cascaded particles fall across the path of the hot gases at right angles. The average velocity of fall is in this case 8·5ft. per second. Taking the average temperature of the hot gases at 525 deg. Fah., their volume is 24·8 cubic feet per pound, and the equivalent value of W

$$=\frac{8\cdot5\times60\times60}{24\cdot8}=1230$$

Before taking a suitable value of H_e from the table or graph provided, the value of W is increased. The falling particle is exposed to two hot air velocities at right angles; hence for the purpose of obtaining H_e only, the equivalent value of W is taken at

$$\sqrt{1600^2+1230^2}=2040.$$

On referring to graph O—November 14th—a suitable value for H_e, for grade V. coal, is seen to be 11·5.

Parallel Flow.—To work out a numerical example using grade V. coal, containing 15·55 per cent. of moisture, the drying is assumed to proceed on the lines of the experiment recorded in Table X.—November 28th—taking the period from 0 to 7 minutes. During that time 95 per cent. of the moisture was evaporated, and the average temperature of the coal rose from 60 deg. to 300 deg. Fah., an increase of 240 deg. The heat supply per 100 lb. of wet coal (or 84·45 lb. of dry coal) was 23,712 B.Th.U.; hence for calculation purposes the equivalent specific heat of the coal, which takes into account the total heat supplied, is

$$\frac{23,712}{84\cdot45\times240}=1\cdot16$$

The equivalent coal surface per square foot of cross section per foot run $c\,S\,e\,f$ was previously shown to be 0·322 square foot. It is also assumed that

$$K=1\cdot42,\ \bar{x}=0\cdot050,\ a\,W=1600, \text{ and } H_e=11\cdot5$$

Air temperature range, 850 deg. to 400 deg. Fah.
Coal temperature range, 60 deg. to 300 deg. Fah.
Formula (12) for parallel flow is used—

$$L_d=\frac{2\cdot303}{Q}\log\frac{a\,T\,i-c\,T\,i}{a\,T\,e-c\,T\,e}$$

L_d now being the length of the cascading channels in feet.

$$Q=\frac{N+M}{N}\times\frac{\bar{H}\times\bar{K}}{M\,(H+\bar{K})}$$

$$M=\frac{1600\times0\cdot24}{60}=6\cdot40$$

Also from (13)

$$c\,W=\frac{1600\times0\cdot24\times450}{240\times1\cdot16}=620 \text{ lb.}$$

$$N=\frac{620\times1\cdot16}{60}=12\cdot00$$

$$\bar{H}=\frac{11\cdot5\times0\cdot322}{60}=0\cdot0616$$

$$\bar{K}=\frac{1\cdot42\times0\cdot322}{60\times0\cdot050}=0\cdot1522$$

and $$Q=\frac{18\cdot40}{12\cdot00}\times\frac{0\cdot0616\times0\cdot1522}{6\cdot40\times0\cdot2138}=0\cdot01055$$

$$\therefore\ L_d=\frac{2\cdot303}{0\cdot01055}\log\frac{850-60}{400-300}$$

$$L_d=\frac{2\cdot303\times0\cdot898}{0\cdot01055}=197\text{ft.}$$

The coal dried per square foot per hour, $c\,W$ =620 lb.; hence the output from a dryer 5ft. 6in. in diameter, or 23·8 square feet in cross section, is

$$\frac{620\times23\cdot8}{2240}=6\cdot58 \text{ tons per hour.}$$

The great length required for the dryer is due to the fact that only lump coal, grade V., is being dried, the size being approximately ¼in. by ¼in. by ¼in. If a mixed sample were used, the weight would be 50 lb. per cubic foot, instead of 35 lb., so that the channels would cascade more coal per foot run, and owing to the smaller grades, the coal surface per pound would be greatly increased. The fine coal, being more rapidly dried, would also assist to dry the larger lumps by contact when mixed together in the channels. The coal is at rest in the channels for about 90 per cent. of the time.

Counter-flow.—Suppose the dryer is worked on the counter-flow system, with $a\,W$=1600, the air temperature range being 700 deg. to 200 deg., and the coal temperature range 60—300 deg. as before; then

$$C\,W=\frac{1600\times0\cdot24\times500}{240\times1\cdot16}=690 \text{ lb.}$$

and $$N=\frac{690\times1\cdot16}{60}=13\cdot34$$

From (15) the formula for counterflow

$$L_d=\frac{2\cdot303}{V}\log\frac{a\,T\,i-c\,T_3}{a\,T\,e-c\,T\,i}$$

where $$V=\frac{N-M}{N}\ \frac{\bar{H}\,\bar{K}}{M\,(\bar{H}+K)}$$

All quantities except N remain as in the previous example; hence

$$V=\frac{6\cdot94}{13\cdot34}\ \frac{0\cdot0616\times0\cdot1522}{6\cdot40\times0\cdot2138}=0\cdot00357$$

and $$L_d=\frac{2\cdot303}{0\cdot00357}\log\frac{700-300}{200-60}$$

$$\therefore\ L_d=\frac{2\cdot303\times0\cdot456}{0\cdot00357}=294\text{ft.}$$

Since the coal dried is 690 lb. per square foot per hour, the dryer output will be:

$$\frac{690\times23\cdot8}{2240}=6\cdot58 \text{ tons per hour.}$$

The air temperature, and, consequently, the coal temperature, at any point in the length of the dryer can be calculated by formula (11) for parallel flow, and by formula (14) for counterflow. The graphs obtained will be similar to those lettered A*i* and A*j*, Figs. 32 and 33.

EFFECT OF GRADE SIZE.

The preceding calculations relate to grade V. coal. Similar figures have been worked out for smaller grades, and the results are entered up in Table XIII. A description of the table is as follows:—

Col. (3). The value of 1600 for a W is suitable, if the coal dust carried out from the interior of the shell can be burned in a rotary kiln, or a boiler, or otherwise disposed of.

Col. (4) The increased rate of drying for counterflow is due to the greater air temperature range.

Col. (5) For parallel flow, since the hot air enters with the wet coal an initial temperature

of 850 deg. Fah. is admissible. On leaving the dryer the air temperature is 100 deg. Fah. above the coal temperature. For counterflow the air temperature leaving the dryer is 140 deg. above the coal temperature.

Col. (7) The values of H_c are obtained from graph O—November 14th—and suitably corrected for the velocity of fall in the dryer.

Col. (8). The coal surface per dry pound is given in Table IX.—November 28th—and the method of obtaining $c\ S\ c\ f$ has been previously explained.

Col. (9). Gives the length of the dryer in feet, as calculated.

Col. (10). In the dryer under consideration—Fig. 18—the coal rests in the cascading channels for approximately half a revolution, or 6 seconds. It then falls in about half a second, during which period the drying is done. In the channels the temperature of any lump will tend to become uniform throughout, and it is suggested that the heating and drying of granular materials was to find out why the rate of heat transmission in rotary kilns, as used for the manufacture of Portland cement, was relatively slow. Such kilns are now being made from 300ft. to 400ft. in length. A large quantity of additional heating surface in the shape of chains, or iron plates, has to be provided in the interior of each kiln, at the cold end, in order to reduce the exit gas temperature to 500 deg. Fah. or similar on the wet process. The life of the added surface is relatively short. On the dry process the exit gas temperature may be 1200 deg. Fah.

A typical cross section of a rotary kiln is shown in Fig. 34. The kiln is inclined at 1 in 25 and makes about 1 revolution per minute. The charge, marked C, occupies about 7 per cent. of the kiln volume. The inclination of the charge surface A B is due to the rotation of the kiln; as the material reaches the highest point it rolls down the chord A B, and thus fresh material is continually exposed to the action of the hot gases.

TABLE XIII.—*Single Shell Rotary Dryer, 5ft. 6in. diameter.*

Line No.	Type of dryer.	Grade of coal used.	Air weight per sq. ft. per hour, lb., a W.	Dry coal, weight per sq. ft. per hour, lb., c W.	Air temperature range, deg. F.	Coal temperature range, deg. F.	Value of H_c used.	Equivalent coal surface per sq. ft. of cross section per foot run, c Scf.	Calculated length of dryer in feet, L_f.	Value of L_f, if K = ∞.	Dryer output, tons per hour, dry coal.
1	Parallel flow ..	V.	1600	620	850–400	60–300	11·5	0·322	197·0	140·0	6·58
2	,, ..	VII.	1600	620	850–400	60–300	19·0	0·605	61·4	45·1	6·58
3	,, ..	VIII.	1600	620	850–400	60–300	31·0	0·980	22·3	17·1	6·58
4	,, ..	IX.	1600	620	850–400	60–300	44·0	2·010	7·3	5·8	6·58
5	Counter flow ..	V.	1600	690	700–200	60–300	11·5	0·322	294·0	210·0	7·34
6	,, ..	VIII.	1600	690	700–200	60–300	31·0	0·980	33·5	25·7	7·34
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)

NOTE.—In all cases, coal moisture = 15·55 per cent., K = 1·42, equivalent specific heat ($c\ \varphi\ e$) = 1·16.

rate of drying may approach that which would be calculated if K is made very large. In formula (12) for parallel flow, if K is made infinitely great, the expression for Q becomes

$$Q = \frac{M+N}{N} \times \frac{H}{M}$$

A similar modification is obtained for V, in formula (15) for counterflow. From the revised values of Q and V, the figures in Col. (10) have been calculated.

Cols. (9) and (10) show the great reduction which occurs in the length of the dryer as the grade size is reduced. The grade dimensions are shown full size in Fig. 21—November 28th.

PROPORTION OF GRADES IN BITUMINOUS COAL.

An average sample of bituminous coal, as used for pulverised fuel, in a rotary kiln, has been graded out, and weighed, with the following result :—

TABLE XIV.

Grade.	Quantity, per cent.
III.	0·67
IV.	0·39
V.	0·27
VI.	3·74
VII.	14·92
VIII.	21·72
IX.	34·72
X.	8·67
XI.	5·30
Dust	9·60
	100·00

From the table it is apparent that a satisfactory length would be calculated for the dryer if all the coal was assumed to consist of grade VIII. Hence, from line (3) of Table XIII., Cols. (9) and (10), a length of 20ft. would be sufficient to deal with an average sample of bituminous coal, which contans 15·55 per cent. of water. Since the rate of drying is governed by the surface area of the coal "in cascade" at any instant, it is evident that by increasing the number of channels, and by speeding up the dryer, the length required for the cascading channels could be brought down to 10ft.

An efficient coal dryer therefore may consist essentially of a short tube, which is fitted with the requisite number of cascading channels and revolved at a suitable speed.

In such a dryer the external radiation loss from the shell would be negligible.

EFFECT OF CASING DRYER SHELL IN BRICKWORK.

A large number of dryers for coal and other materials have been built in which the hot air passes first round the outside of the dryer shell and afterwards through the interior. The value of H_c between the hot gases and the dryer shell is seldom more than 2·0; hence the percentage of the total heat which is transmitted through the shell will usually be small. The same remark applies to a dryer provided with an inner tube.

A brick encasing chamber, or an inner tube, may, however, be essential when only a slow rate of air flow can be used through the cascading material, in order to minimise the production of dust. The dryer then becomes relatively large.

HEAT TRANSMISSION IN ROTARY CEMENT KILNS.

It was stated at the commencement of these articles that one reason for making the experiments on the

The kiln is worked on the counterflow system; hot gases, produced by pulverised coal, pass through the shell in the opposite direction to the charge.

In the clinkering zone, where the material (a mixture of chalk and clay) is nearly fused, the heat transmission is by radiation, but for about four-fifths of the length of the kiln the heat is transmitted from the hot gases to the chord A B of the material or to the inner surface of the firebrick lining, mainly by convection, and the value of the H_c realised—which includes some radiation from the gases H_2O and CO_2—is from 5 to 6. The flat surface of the chord A B is taken and not the surface of individual particles.

The heat received by the firebrick lining from the hot gases is transferred by radiation to the upper and under surfaces of the charge, but in this double process the temperature difference, available in each case for heat transfer, is substantially less than that between the hot gases and the material in the kiln.

For a 275ft. kiln an average value of W, the weight

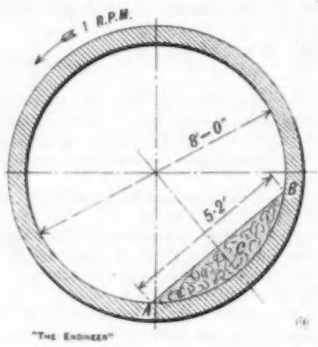


FIG. 34—SECTION OF ROTARY KILN

in pounds of the hot gases passing per square foot of cross section per hour, will be about 1900, and it has been found by an analysis of the test results of several kilns that the total heat received by the charge in B.Th.U. per foot run of kiln per hour is approximately given by the expression

$$30 \times A\ B \times T\ d,$$

when the ratio of the chord A B to the kiln diameter is substantially as shown in Fig. 34. In this case A B = 5·2ft., and the expression reduces to 156 T d.

The actual temperature difference, T d, between the hot gases and the material of the charge may vary from 500 deg. to 1800 deg. Fah.

As previously mentioned, this is the rate of heat transmission which obtains over about four-fifths of the length of the kiln, and it corresponds to a transfer of about five-eighths of the total quantity of heat received by the material. In the clinkering zone, where the heat is transmitted by radiation, the action is considerably more rapid.

Actual Surface of Charge.—For calculation purposes we may assume the charge to consist of spheres between $\frac{1}{8}$in. and $\frac{1}{4}$in. in diameter. The cross section of the charge C is, in this case, 3·52 square feet, and the weight per foot run will be

$$3{\cdot}52 \times 90 = 317 \text{ lb.}$$

The surface area of the material is 2·27 square feet per pound; hence the total material surface per foot run will be

$$317 \times 2{\cdot}27 = 720 \text{ square feet.}$$

Now, suppose the whole of the material to be fully exposed to the action of the hot gases, the value of W is 1900, and the corresponding value of H_c for spheres of the size assumed will be approximately 29·0. Hence the total heat transmitted in B.Th.U. per hour per foot run of kiln is

$$29 \times 720 \times T\ d = 20{,}800\ T\ d.$$

Hence the increase in the rate of heat transmission is

$$\frac{20{,}800}{156} = 126 \text{ times.}$$

It will be apparent from the approximate calculations now made that the rate of heat transmission in a rotary kiln is slow because the heat is only supplied to the outer surfaces of the charge in the kiln and not to the surface of each individual particle.

There are, of course, practical difficulties in the way of fully exposing each particle of the material to the action of the hot gases, for, say, 40 per cent. of the time during which it remains in the kiln, but since the advantage of doing so is now clearly understood, it is hoped that a radical improvement in the design of rotary kilns will not be much longer delayed.

The Early Days of Gas Lighting.

By P. G. CRACROFT, City of Hull Water and Gas Undertakings.

No. II.*

THE evidence of Accum, the German chemist, and author of "A Practical Treatise on Gas Light" (1815), who appeared in support of the application, was bitterly ridiculed by the Committee; while the great Henry Brougham, Baron Brougham and Vaux, later Lord Chancellor, who was counsel for the petitioners, made havoc of Winsor's fantastic speculations. Boulton and Watt petitioned against the Bill, and Murdoch gave evidence. "Do you mean to tell us," asked one member of the Committee, "that it will be possible to have a light without a wick?" "Yes, I do, indeed," answered Murdoch. "Ah! my friend," said the legislator, "you are trying to prove too much." And so the Bill was thrown out, killed by extravagant claims on the one hand and by too great a regard for truth on the other. It had one good result however—it proved incontestably Murdoch's claim to priority in adopting gas for illumination. The delay in obtaining parliamentary powers proved not to be a long one, for, in 1812, Winsor and his subscribers succeeded in securing their Act of Incorporation, and then formed the "London and Westminster Chartered Gas Light and Coke Company," in Cannon-street, Westminster, next removed to Peter-street, Westminster, with works in Brick-lane, St. Luke's. The capital was £200,000. Winsor's son is buried in Kensal Green Cemetery, and, at his tomb there is a monument which describes his father as the "originator of public gas lighting." Winsor obtained the first patent in connection with gas lighting, a stove to reduce raw fuel into coke and charcoal, the smoke being conducted through cold air or water into a condenser, to be resolved into tar, pitch, &c. Having this patent, Winsor described himself as the discoverer, inventor, and patentee of gas lighting.

At first, the company was not very successful. Many prejudices existed against the new light, which, be it said, was poor, and the smell offensive. It was on the point of dissolution when Mr. Samuel Clegg came to its aid, and, with his previous knowledge of erecting gasworks, installing gas apparatus, and acquaintance of the arrangements which Murdoch had invented, the company made good progress. Clegg introduced the system of wet-lime purification, the hydraulic main with dip pipes, the governor, and the gas meter.

From 1813 to 1815 a few of the more important parts of London to be lighted for the first time were :—

1813 .. Westminster Bridge
1814 .. St. James's Park; the pagoda and bridge was lit simultaneously by 10,000 lights, in commemoration of the Peace of Europe
.. St. Margaret's Parish
1815 .. The Guildhall

Mains were first laid in the City in 1814, and on Christmas Day in that year began the general lighting of London with gas. It is presumed that the citizens would take full advantage of the occasion. The subject of gas lighting was so prominent at that time that it occupied the attention even of a prison inmate! It is recorded that the great Lord Cochrane, the celebrated rear-admiral and Member of Parliament, while under arrest on what proved to be an utterly false charge, occupied himself with the invention of a street gas lamp.

The turn of the provincial cities now came, and in 1817 Glasgow adopted gas; in the following year Liverpool, Dublin, and Leeds followed suit; Huddersfield began operations about the same time; and in 1819 Sheffield was first lit. In 1821 Kingston-upon-Hull obtained an Act to supply one area of the town, and it was calculated that the gas there cost about one-third the price of candles, a hundred cubic feet

* No. I. appeared December 5th.

of gas, valued at from 5s. to 6s., yielding as much light as 18 lb. of tallow candles. By 1819 several other towns, including Edinburgh, Manchester, and Birmingham, were in possession of Acts or had actually begun to supply gas. In London, three other companies had established themselves—the City of London, the South London, or Phœnix, and the Imperial. In 1822 St. Paul's Cathedral was experimentally lighted with gas, and St. James's Park was illuminated; in 1824 Grosvenor-square was lit, and, on June 13th, 1825, portable gas was employed in illuminating the Monument on Fish-street Hill, in commemoration of laying the first stone of the new London Bridge.

The success of coal gas now began to attract the attention of some scientific men, who, about 1819, reported favourably on a patent obtained in 1815 by John Taylor. The invention was designed to produce gas from "any kind of animal, vegetable, or mineral oil, fat, bitumen, or resin, which is or can be rendered fluid by heat or otherwise," and in order to purify this gas it was passed through lime and water, or through dilute acids. The patent was acquired by a few influential gentlemen, and some companies, which were projected to light some towns in the kingdom, were induced to construct their works for its manufacture. It was claimed for this oil gas that it yielded three, and even four, times the light of coal gas, but, when the London and Westminster Oil Gas Company was projected, the coal gas companies petitioned the House of Commons against the Bill. They were successful, at an expense of about £30,000, and the Oil Gas Company failed in its application. At that time also the London Portable Gas Company was formed for the sale of gas in copper receivers of the capacity of about 2 cubic feet each. This was the result of a patent obtained by David Gordon, but the company, after transacting business for some time, ceased manufacture and was dissolved.

The prejudices which at first existed against the use of gas and the curious ideas as to how it operated, make strange reading to us at this distance of time. Sir Walter Scott, when he heard of Winsor's efforts to form a gas company, said that there was a madman in London proposing to light the City with—smoke; which calls to mind Dr. Johnson's remark, when he watched the lamplighter re-lighting the wick of an oil lamp. The great author and poet, however, saw his error, and made amends by lighting his house at Abbotsford with the derided smoke. Davy, Wollaston, and Watt at first gave an opinion that coal gas could never be safely applied to the purposes of street lighting, and Wollaston further declared that one might as well attempt to light London with a slice from the moon.* Davy was very sceptical, thought the project the maddest of mad ideas, and said that to get all the gas required, the dome of St. Paul's would be needed. As to capacity, he was right, for the gasholders of London to-day greatly exceed in dimensions the dome of St. Paul's. Insurance companies at first opposed the new illuminant, and Parish Councils would not allow gas lamps to be fixed on the existing wooden posts. When the old House of Commons was first illuminated with gas, the pipes were ordered to be fixed quite clear of the walls, in case the pipes became red hot and set fire to the building! Members of Parliament, too, formed the same idea, and provided themselves with thick gloves, in case the pipes should burn their hands; they were greatly impressed to find that the metal was quite cold to the touch. When Westminster Bridge was piped in 1813 the popular conception of gas was that the light extended throughout the pipes, and that the turning of the taps simply released the imprisoned flame! And it is also recorded that a fashionable lady, seeing one of the earliest lamps on a shop counter, wished to take it home in her carriage, there and then.

From 1802, when Murdoch illuminated the Soho Foundry, to the close of 1822, a period of twenty years, the growth of gas lighting was so great that, according to a report of Sir William Congreve, the Inspector of Gasworks, that the capital invested in the undertakings of the Metropolis alone was £1,000,000; while the pipes connected with the various establishments were more than 150 miles in length. Into private dwellings, however, owing to imperfect knowledge of the management of gas and the poor workmanship displayed in fitting service pipes, the introduction of gas was a slow process. The quality, too, varied greatly, and the following tests, which were taken in 1865, show that London was not supplied with good gas, and compared badly with other places:

Place.	Illuminating power in standard sperm candles.
London	12·1
Birmingham	15·0
Liverpool	22·0
Manchester	22·0
Edinburgh	28·0
Glasgow	28·0
Greenock	28·5
Hawick	30·0
Aberdeen	35·0

In spite of the low illuminating power, gas was in great demand in London, and in that year 1¾ million pounds was paid by consumers, compared with half a million pounds in 1844, when there were 400,000 consumers and 180,000 tons of coal were used annually in the making of 1,460,000,000 cubic feet of gas. The capital invested was £2,800,000, nearly three times as great as in 1822. In five years, between the latter year and 1827, the consumption of gas was nearly doubled. And it is stated that in 1864, fifty years after the first company was formed, it was not the practice to lay pipes to dwelling-houses for the working classes at the time of erection, and to lay pipes to old houses, by reopening the pavements, was "a seldom recurring art."

Of the developments of the industry since the early days it is not possible, in this brief survey, to write at any length. The researches and inventions of Lavoisier, Lowe, Creighton, Clegg, Dr. Henry, Chaussenot, von Bunsen, von Welsbach, and others, can only be recalled; it is beyond the scope of this article to describe them in detail.

Included in some of the stages of the developments, the invention of the gasholder by Lavoisier, the great French chemist, in 1781, takes precedence in point of time. The date is actually before Murdoch's production of gas in 1792, and it is thought possible that this event caused him to renew his experiments. Later, in 1814, the Royal Society strongly recommended the Government to restrict the chartered company from constructing gasholders exceeding 6000 cubic feet in capacity, the holders to be situated in very strong buildings! Stoking was attempted by mechanical means by Creighton as early as 1808, and afterwards by Samuel Clegg, Brunton, Grafton and others. It was not until 1861, however, that any practical apparatus was made. It was patented by Green, but he did not take any steps to give it publicity, so that it passed unnoticed.

The first gas meter was invented and constructed in 1815 by Samuel Clegg, who did so much to put the gas industry on its feet, and to establish gas technique on a sound footing. By precept and example, and by his own inventions and knowledge he inspired others, in the early days, to overcome difficulties which seemed at times insurmountable. He did not hesitate, when the lamplighters went on strike against the new light, to shoulder a ladder and to perform a lamplighter's duties; he was a true pioneer. Clegg patented the meter as "a gauge or rotative gas meter," but the action was imperfect, and when the meters were manufactured, a regulator was attached to counteract the oscillation of the lights. Two years later John Malam invented another description of instrument for measuring gas, and that led to the construction of a meter which was later universally employed. The Society of Arts awarded him its Gold Medal, but he did not patent the invention. He did, however, in 1820, patent the first dry meter recorded, but the patent was not practicable, nor was it ever carried into effect. The dry meter of practical use was invented by Mr. Richards, when in the service of the Chartered Company, and patented by him in 1844, in conjunction with Mr. Croll, who was then superintendent of the Brick-lane station of that Company.

Retorts were, in the first instance, made of cast iron. About 1820 clay retorts were introduced at Wolverhampton, and the first application of lime for purifying gas appears to be due to Dr. Henry and Clegg. The station meter was introduced in 1820. The year 1824 saw the granting of a patent to Ibbotson for the production of hydrogen gas, which he proposed to mix with tar or coal, in a state of ignition, as a substitute for coal gas. A few years afterwards, Michael Donovan patented the means of enriching those gases which afford little light when burning, such as hydrogen, "produced by the action of steam on coke heated to redness." Later, Lowe applied the vapours of naphtha and other light hydro-carbons to enrich coal gas. And, in 1847, Mansfield patented a means of passing atmospheric air at ordinary temperatures through bituminous substances. These inventions form the foundation of the different processes known generally by the terms "water gas," "carburating gas," and "air gas."

Concerning burners, Murdoch introduced "bengal lights"—flaming open burners—in 1802, and J. B. Neilson, of Glasgow, introduced the fish-tail burner in 1820. Aimé Argand, the chemist and physician, invented the Argand burner in 1782 for oil lamps. About 1836 Chaussenot patented the system of making the burner with two concentric glass chimneys, but it was not practically applied, owing to the inner chimney becoming distorted by heat. R. W. E. von Bunsen, the professor of chemistry, about 1855, invented the burner bearing his name, and in 1895 Dr. Carl Auer von Welsbach discovered the gas mantle.

Gas for culinary purposes was used many years ago. The first authentic recorded use of gas for domestic purposes was about 1830–1832, when Mr. J. Sharp, of Northampton, demonstrated the availability of gas for cooking in his own home; but, although apparatus for cooking and heating were made in London about that time, they were not appreciated by the public. In 1851 Mr. E. Goddard made important improvements in the apparatus, and at his suggestion, the Ipswich Gas Company let them on hire to its customers, being the first gas undertaking to do so. The innovation was not successful, and was shortly afterwards abandoned. Later, in 1857, the manufacture of cooking stoves having been begun, the Maidstone Gas Company tried the system with complete success.

The "sliding scale" of charging was first suggested by Mr.—later Sir—George Livesey, President of the British Managers' Gas Association, when he delivered his opening address in 1872. The Board of Trade and the Metropolitan Board took up the suggestion, and the Regulation Bill was submitted to Parliament and passed. The companies in London strenuously opposed the proposal, and for a session it remained in abeyance. The Commercial was the first company to adopt the scale, in its Act of 1875. Since that time the principle has been extended in practice, in a way similar to that in which the scheme of income tax, designed in more leisurely days, has been developed from a simple system to a complex method, calculated to suit modern conditions of life. A minimum dividend has been authorised, also a basic price and dividend arrangement, with dividends in an upward direction only for shareholders, and equal payments to co-partner employees.

The last important event to be noticed is the introduction of the method of charging for gas on a therm basis, in lieu of cubic feet, and the replacement of the old candle-power standard tests by the calorific value test. These requirements, contained in the Gas Undertakings Acts, 1920 and 1929, are now being administered by almost all the statutory undertakings in the country. The changes in the standard of testing had been sought by undertakings for some years before the war, and the Gas (Standard of Calorific Power) Act, 1916, enabled many of them to adopt a calorific standard. The advent of the incandescent mantle rendered an illuminating power test of minor importance, and the growing use of gas for cooking and heating favoured a change from a lighting standard to one of heat value. The Act of 1920 adopted, with slight modifications, the code of testing which for many years has regulated the testing of public gas supplies in London; as is well known, the duties are performed by a Chief Gas Examiner, three Gas Referees, and assistants.

The Rev. John Clayton, D.D., Dean of Kildare, the discoverer of gas lighting, was born in 1657. He came of a Lancashire family of divines and lawyers, merchants and squires, which, according to one historian, could trace its members back to the twelfth century. He matriculated in 1674, took his B.A. degree in 1677–8 and M.A. in 1682. He then became the Rector of Crofton, near Wakefield, in 1687, and later, in 1698, he was preferred to the living of St. Michan (St. Michael), Dublin, and also instituted a Prebendary of Christ's Cathedral. In 1705 he was collated a Canon of Kildare, and elected Dean in 1708, dying at Dublin on September 23rd, 1725. He was a splendid example of the English clergyman with a taste for scientific pursuits, of whom there are not a few.

William Murdoch, or Murdock—the name is spelled both ways—the introducer of the practical application of gas lighting, was born in the parish of Auchinleck, Ayrshire, on August 21st, 1754, not far from the world-famous cottage where Robert Burns was born. His mother was a Bruce and claimed descent from Robert Bruce, the deliverer of Scotland. His father was a millwright and designed the first iron tooth gearing ever used in mill work; both father and son were mechanical geniuses. It is said that William Murdoch possibly obtained his first idea of gas as an illuminant while tending his father's cattle. He hewed a square compartment out of the rock by the waterside, and there burnt the splint coal found on the top of the Black Band ironstone. The little cavern was provided with a complete fire-place and vent.

When he was about twenty-three years of age Murdoch began work with Boulton and Watt at their steam engine works at Soho, Birmingham, and was sent by them to superintend the erection of colliery engines in Cornwall, where, at Redruth, he lit his house with gas. While there he was always inventing unusual contrivances, but chiefly experimenting in the illuminating properties of gases obtained by distilling coal, wood, peat, and other combustible substances, which led him to the idea of collecting these gases and expelling them through jets for lights. Several independent inquirers into the constituents of Newcastle coal had arrived at the conclusion that one-third of the substance was driven off in vapour by the application of heat, and that the vapour was inflammable. But no suggestion had been made to apply that vapour for lighting purposes until Murdoch took the matter in hand. He was a very modest man, and in the paper he read before the Royal Society in 1808 "On the Application of Gas from Coal to Economical Purposes," he concluded by saying: "I believe I may, without presuming too much, claim both the first idea of applying, and the first actual application of this gas to economical purposes." When he started work with Boulton and Watt his wages for a two years' engagement were 15s. per week when at home, 17s. when in the country, and 18s. when in London. Down to 1780 his wages were only £1 per week.

The process of the application of gas lighting as evolved by Murdoch was not patented by him, and the only advantage he derived from the extended use of the new system of lighting was the honour of having introduced it. He left the advantages to the public and devoted himself to mechanical pursuits, inventing such things as the slide valve, rotary engine, lifts worked by compressed air, cement for cast iron and a pneumatic tube for the transmission of letters. In the midst of this work, however, he was growing old,

* This statement is usually attributed to Sir Humphrey Davy.—ED. THE E.

THE PLATT-TOYODA AUTOMATIC LOOM—MECHANISM

PLATT BROTHERS AND CO., LTD., OLDHAM, ENGINEERS

(For description see opposite page.)

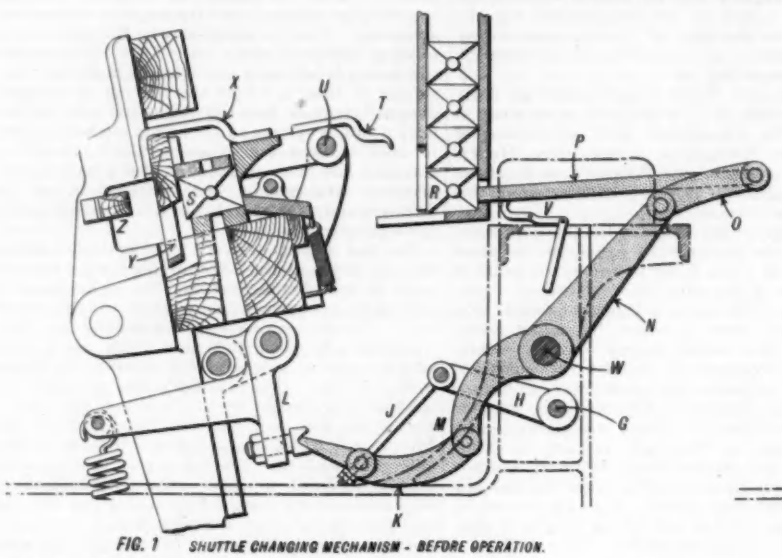


FIG. 1 SHUTTLE CHANGING MECHANISM - BEFORE OPERATION.

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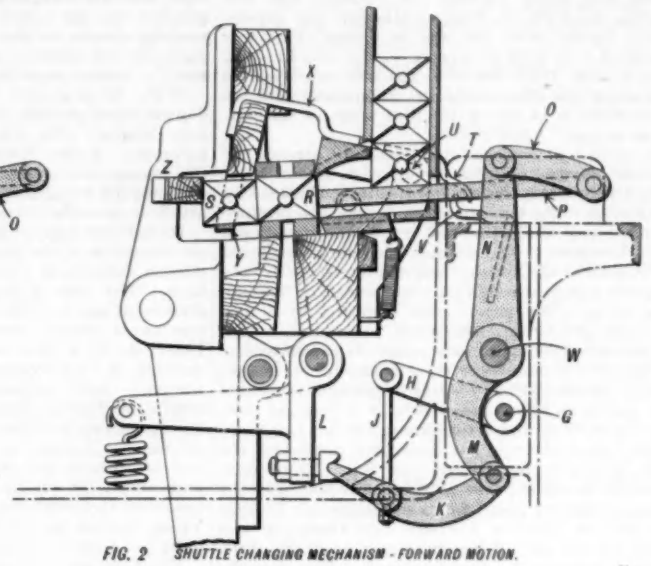


FIG. 2 SHUTTLE CHANGING MECHANISM - FORWARD MOTION.

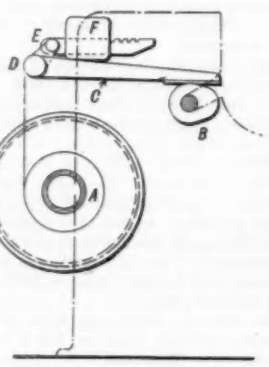


FIG. 3

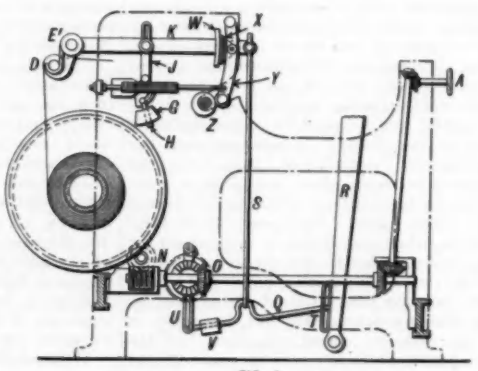


FIG. 4

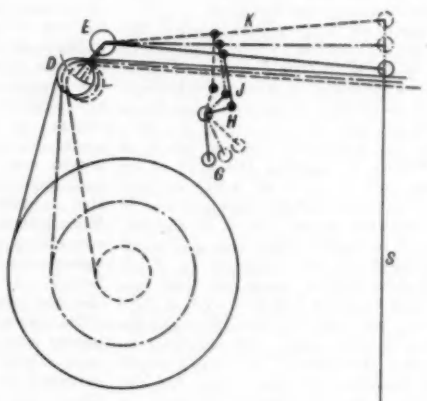


FIG. 6

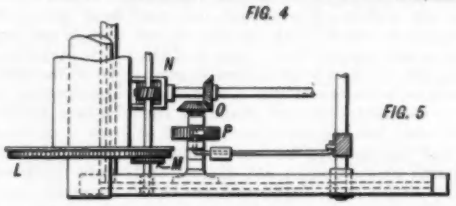


FIG. 5

"THE ENGINEER"

MECHANISM FOR AUTOMATICALLY MAINTAINING CORRECT TENSION

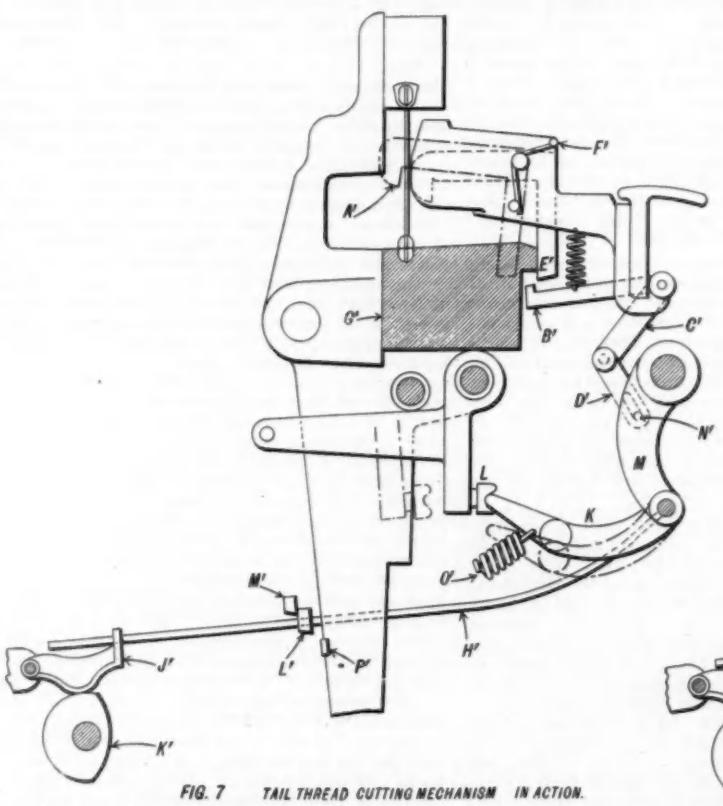


FIG. 7 TAIL THREAD CUTTING MECHANISM IN ACTION.

"THE ENGINEER"

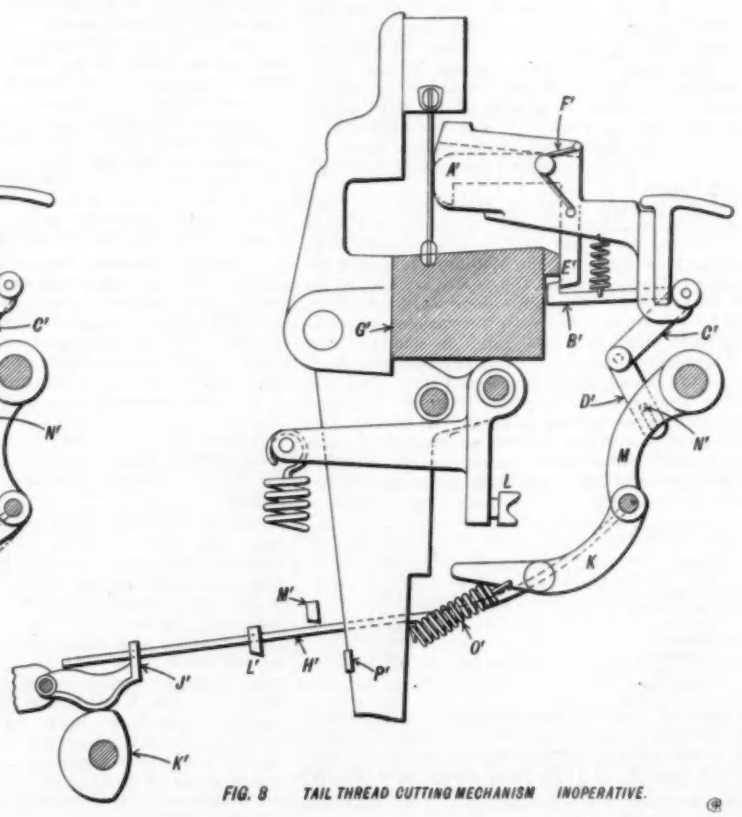


FIG. 8 TAIL THREAD CUTTING MECHANISM INOPERATIVE.

and he died at his home at Sycamore Hill, Handsworth, on November 15th, 1839, in his eighty-fifth year, being buried near the remains of Boulton and Watt. Sir Francis Chantrey executed a fine bust of Murdoch, which reveals forcefully the latter's expressive and intellectual features. After reviewing the fruits of a long life of great endeavour and judging its benefits to mankind in general, Murdoch might truthfully have said "*Non omnia moriar.*"

The Platt-Toyoda Automatic Loom.

THE long and serious depression which the cotton textile industry is experiencing makes it incumbent on manufacturers of cotton fabrics in this country to investigate the claims of any and all appliances which have for their object the cheapening of production. One of the most important means to that end is what is known as the automatic loom. Many attempts have been made to design looms of that description, and large sums of money have been expended by inventors in producing machines with self-acting weft-replenishing devices.

The first attempt in this direction dates back more than ninety years. Many inventions with the same end in view have, since that time been introduced and been discarded; others never reached the stage of actual construction; while a few survive to the present day. The automatic looms now available may be broadly divided into three classes, as follows:—(1) Shuttleless or continuous-weft supply looms; (2) bobbin changing looms; and (3) shuttle changing looms. The shuttleless loom obtains its supply of weft from a larger source than the usual shuttle cop, and it is only in recent years that efforts in that direction have achieved any considerable degree of commercial success. The shuttleless loom draws its supply of weft from large cone packages at the sides or rear of the loom. In one type of loom the function of the shuttle is performed by two picking rods at opposite ends of the machine. One of these rods carries an end of weft to the middle of the warp shed. The weft end is then transferred to the second rod, which, in withdrawing from the shed, completes the pick. This process is repeated from alternate ends of the loom and the picks of weft are severed at the ends and tucked into the selvedge of the fabric. A second loom of the same class uses but one rod and inserts a double pick into each shed. The loop of weft in this case is retained at the further end of the shed by a selvedge thread, which is carried in a small oscillating shuttle, on a somewhat similar principle to that employed in some kinds of carpet looms. There is a third type of loom, known as the Platt-Gawsworth, which draws its weft supplies from large packages at the rear. Instead of using the ordinary shuttle this loom utilises a narrow carrier for transporting the weft through the shed and the smallness of section of the carrier permits a smaller warp shed which has obvious practical advantages. For many varieties of cloth this loom works very efficiently.

The essential mechanism of the bobbin-changing loom was invented as long ago as the year 1857 by Patrick Macfarlane, and with the addition of several other inventions by W. F. Draper, this loom achieved commercial success in 1894. Many alterations and improvements have been introduced since that time in connection with the change mechanism without altering the main principle, which remains the chief element in all bobbin-changing systems. The operation of bobbin changing is effected by a striker which is actuated by the changing mechanism and forces the full bobbins from the magazine into the shuttle. On entering the shuttle the new bobbin expels the exhausted bobbin and the continued movement of the striker presses the base of the new bobbin into a spring grip in the shuttle.

This operation requires a considerable amount of force, which increases with the speed of changing. In order to reduce the striking force by slowing down the speed of changing the bobbin, some looms are provided with a swinging magazine. By this means the magazine is kept in position over the shuttle box for a short period, during the movement of the sley, but the mechanism for performing this operation adds to the moving parts. Without this additional feature it is necessary to effect the changing of the bobbins during the brief period when the sley is at its front centre, in which case the striking force reaches its maximum. The operation of changing bobbins while the loom is in motion demands a refinement of timing mechanism and requires most careful adjustment to obtain correct inter-relationship. In the stationary magazine type of loom the essential action consists in synchronising the vertical movement of the striker with the horizontal motion of the sley, besides requiring the correct placing of the shuttle in its box, because a slight departure from the correct position in either of these directions may cause a faulty change.

In many non-automatic looms there are relatively large irregularities in the positions of the shuttle and the sley when the crank is at its front centre. Wear in the rocking shaft bearing gives rise to variations in the vertical position of the sley amounting in some cases to ¼in., while the horizontal position of the sley may be seriously affected by the wear of the crank shaft and its bearings, as well as by the wear of the connecting-rod bearing and pins. By reason of the connecting-rod being attached to the sley sword at a point nearer to its fulcrum than is the shuttle box, the ill effects of play in the various bearings mentioned are increased. It will be seen therefore that the attachment of bobbin-changing mechanisms to such looms is liable to cause faulty working. The bobbin-changing loom, built as such, minimises these troubles by improved bearings and by reducing the speed of operation.

The third class or shuttle-changing loom only dates back about thirty years for its origin, and looms of this kind were first used in America. In most of these shuttle-changing looms the shuttle is transferred from the magazine to the shuttle-box in a horizontal path—a condition which allows more latitude in the timing and setting of the various parts than when the objects are moving in directions perpendicular to each other. The change mechanisms operate on the shuttle, and there is consequently less likelihood of damage to the yarn. There are different methods of carrying out the shuttle-changing process. In some looms the movement of the sley is arrested, which sacrifices to some extent the speed of production. Another loom avoids this delay by providing for the preliminary transfer of the shuttle from the magazine to a receptacle on the sley, whence it is moved by a second operation to the shuttle-box. In some cases the spent shuttles are ejected through the front of the box, through which the new shuttle also enters. As separate pieces of mechanism are thus required, careful timing of the respective operations is essential to avoid collision of the shuttles, and the speed of the loom is not so great as that of an ordinary Lancashire loom.

The Platt-Toyoda loom, of which we give illustrations on page 652, is of Japanese origin. Although it is new to this country, we are informed that there are several thousands at work abroad, where they have given complete satisfaction. It is built on the shuttle-changing principle, and in designing it the inventor retained many features of the Lancashire loom. For a given cloth width its running speed is at least equal to and in many cases higher than that of a first-class loom of the non-automatic kind. Under average working conditions the makers—Platt Brothers and Co., Ltd., Oldham—claim for the loom an efficiency of from 94 to 98 per cent., representing an increase of production of from 11 to 17 per cent. per loom compared with the non-automatic loom and, in addition, when it is possible to obtain higher speeds as on many cloths, the increase of production may rise to about 30 per cent.

In the Platt-Toyoda loom the shuttle is changed while the machine is running at full speed. This portion of the mechanism is constructed in such a manner that the pusher bar action completes the shuttle change without any auxiliary mechanism for opening the shuttle box sides and ejecting the spent shuttle. Its principle is such that a wide tolerance is permissible in the positioning of the exhausted shuttle, and ample time is allowed for the performance of the change. The smooth action of the replenishing operation and the precision with which it is conducted, leaves the shuttle undamaged by the repeated changes and does not injure delicate yarns.

Furthermore, the correct operation of the change mechanism is not dependent on the exact positioning of the shuttle in the box, and it is possible to employ a resilient check action, which is, of course, a great advantage and makes for simplicity and ease of operation. In addition to the shuttle changing mechanism, the Platt-Toyoda loom has an improved warp stop motion for the detection of broken threads and to reduce the number of stoppages to a minimum there is a patented warp let-off motion, which, by means of simple compensating devices, maintains, automatically, the correct tension of the warp. Ordinary cops or pirns can be made use of, but when weaving "pick-found" cloth waste weft can be reduced by a novel feeler motion and the use of special pirns, shown in Fig. 9. These pirns are suitable for direct-ring spinning. The shuttle capacity can also be utilised to the full, whereas in the case of the bobbin-changing loom space must be provided to permit the entrance of the new bobbin in the event of inexact positioning of the bobbin or shuttle. The patented weft-cutting device which trims the threads after weft replenishing is operated only when actuated by the shuttle-changing mechanism, and a long life is assured for the cutting blades.

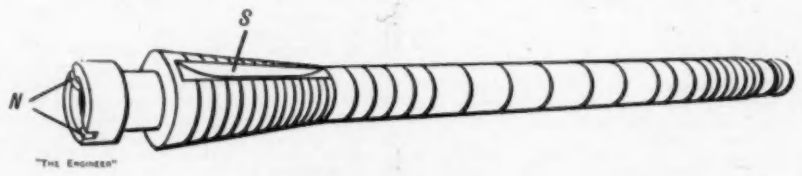


FIG. 9—SPECIAL PIRN

SHUTTLE CHANGING MECHANISM.

The shuttle changing apparatus can be regarded as the heart of the loom. In Figs. 1 and 2, page 644, are given cross sections through the sley showing this mechanism diagrammatically immediately before and during operation. In Fig. 1 the exhausted shuttle S is shown in the shuttle box and the sley is moving towards the front centre. The feeler motion has operated through the shaft G, lever H, and rod J to lift the arm K into the path of the striker block L on the sley sword. This arm K is jointed to the lower end M of a lever N which is mounted on a stud W. The upper end of the lever N is connected by a link O to the pusher bar P. Continuing its forward motion, the sley brings the striker block L into contact with K and through the lever system described the pusher bar P is put into motion to effect the shuttle change. In Fig. 2 the pusher bar has transferred the lowest shuttle R from the magazine to the box.

It will be observed that the shuttle box front and back are attached to a lever X which is fulcrumed at U. Normally this lever is held down by a spring, but owing to the wedge shape of the box front the incoming shuttle in its movement towards the box raises the front, and with it the back of the box. In this way, without separate mechanism, the entry of the new and the exit of the spent shuttle are effected. The ejected shuttle S supported by a stirrup Y carried from the box back is pushed against a stop Z and thus serves to locate the new shuttle correctly in the box. As soon as this position is reached, the front and back of the shuttle box snap into their places and the ejected shuttle is allowed to slide into a receptacle at the side of the loom. With the backward movement of the sley, the pusher bar is withdrawn and the shuttles in the magazine drop into position for the next change. Should any obstruction prevent the correct operation of the changing mechanism the loom is stopped by the action of the finger T. An imperfect change prevents the fall of the lever X and the finger T being connected to this lever is held in its downward position. In this position on the backward movement of the sley it trips the lever V which acts upon the starting handle to stop the loom.

A motion is also provided to stop the loom when the shuttle magazine is empty. For that purpose a catch fixed to the bottom of the magazine supports a wire connected to a hooked lever on the underside of the loom. This catch is held up by the lowest shuttle in the magazine. When the latter is empty the catch falls and moves a finger to a lower position, where it is struck by a projection on the sley sword. The movement thus imparted to the finger, stops the loom through simple connections to the starting handle.

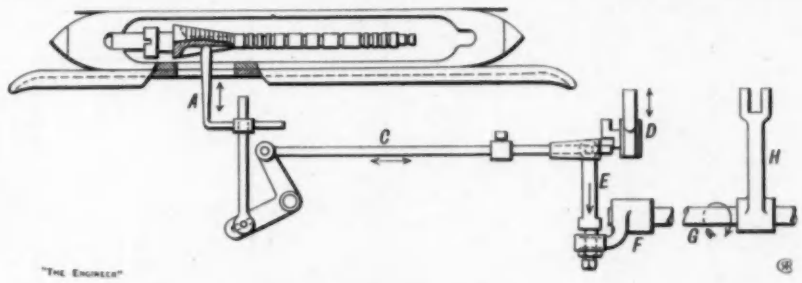


FIG. 10—FEELER MECHANISM

FEELER MECHANISM.

The feeler mechanism shown in Fig. 10 is a simple and ingenious device for detecting the approaching exhaustion of the pirn or cop in the shuttle and sets the operation of the shuttle changing mechanism after the next pick. In the diagram A is the feeler, which, at each pick, enters a slot in the side of the shuttle and makes contact with the weft. The feeler is so adjusted that this contact occurs just before the sley reaches the front centre. By the further travel of the sley, therefore, the feeler is moved and the movement is communicated through the bell crank lever to the rod C. The motion is so timed that the end of the rod C is withdrawn from the path of the weft hammer D which oscillates in the usual manner. Upon the approaching exhaustion of the weft, a slot in the pirn is uncovered and the feeler enters the slot. In that event no motion is transmitted to the feeler by the continued movement of the sley, and therefore the end of the rod C is struck by the weft hammer. In that way the hammer, through the arm E, acts on the lever F attached to the shaft G and the turning movement imparted to the latter operates to bring about the change of shuttle in the manner already described.

The pirn—Fig. 9—is specially made with opposite slots S and is registered in the shuttle by the engagement of the notches N with a peg on the shuttle tongue. With this pirn the feeler operates effectively within a wide range of shuttle positions and the amount of waste weft is reduced to a minimum. The feeler will also operate effectively when the shuttles are filled with mule cops placed on spring tongues, or with ordinary weft ring spinning pirns. Weft breakages may be dealt with in either of two ways according to the requirements of the cloth being woven. For "pick-found" cloth the weft fork is set to stop the loom in the usual manner. Where the type of cloth permits, however, the weft fork can by a simple adjustment be set to operate the change mechanism.

WARP TENSION REGULATOR AND LET-OFF MOTION.

The breakage of warp threads is largely due to incorrect tension of the warp, and in the Platt-Toyoda loom mechanism is provided for maintaining the tension automatically correct. Once adjusted, this mechanism fully compensates for the effect of varying diameter of the warp beam and needs no further attention by the weaver. Figs. 3, 4, 5, and 6 help to explain how this mechanism acts. The warp threads pass over the back rest D, which is pivotally mounted at E and is loaded by a weight F to apply tension to the warp. Attached to the back rest is a lever C, which, through the action of the cam B, eases the tension during the period of shedding. As the diameter of the warp beam becomes reduced, the angle formed by the warp in passing over the back rest D becomes increasingly acute and consequently the tension tends to diminish. To counteract this tendency a supplementary weight G—Fig. 4—carried on the arm H is connected to the back rest weight lever through the arm H and link J. Thus, as the back rest lever is lifted by the effect of the warp angle, the supplementary weight is raised to a more

effective position and thereby increases the pressure of the back rest. In this way the tension on the warp is maintained constant. As the position of the back rest lever K is determined by the diameter of the warp beam, that lever is used to control the rate of warp let-off, which must, of course, be maintained constant. The beam flange incorporates a gear wheel—Figs. 4 and 5—which is driven by a pinion through worm gearing N and bevel wheels O. These bevel wheels are driven by a ratchet wheel P which is actuated by a connecting-rod Q from the sley sword R. The connecting-rod is suspended from the rod S and its ends are free to take up various positions in the slots T and U. The rod is attached to the back rest lever K, and as the latter is raised owing to the diminishing warp diameter, the connecting-rod Q is also raised. A light weight V keeps down the end of the connecting-rod in the slot U until the other end reaches the top of the slot T. These movements, shown diagrammatically in Fig. 6, result in progressive increases in the movement of the ratchet wheel P, and, in consequence, the warp beam is given the necessary additional rotation to compensate for its reduced diameter.

In order to prevent vibration of the back rest during the beat-up, a braking surface W—Fig. 4—is provided at the end of the lever K, and at the right moment the brake block X on the lever Y is caused to press against the braking surface by means of a cam Z and spring, thereby holding the back rest rigid. To facilitate unweaving, a hand wheel A—Fig. 4—at the front of the loom is connected to the bevel wheels O. A pedal, also at the front of the loom, is depressed to disengage the ratchet wheel drive, after which the warp beam can be unwound and rewound by means of the hand wheel.

Tail Thread Cutting.

On completion of the shuttle changing operation, it is necessary to sever the tails of weft left by the new and

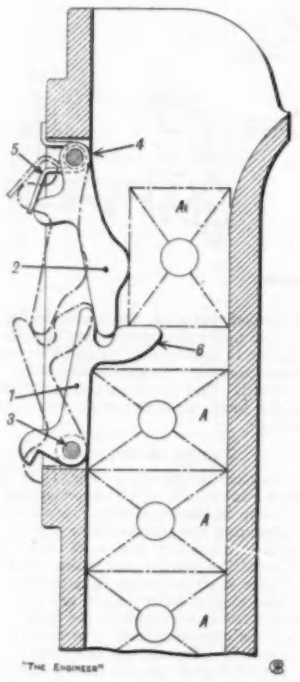


FIG. 11—SECTION THROUGH SHUTTLE MAGAZINE

ejected shuttles. For that purpose the mechanism shown in Figs. 7 and 8 is provided. It serves to operate a cutter which is supported by the temple. Fig. 8 shows the parts in their inoperative position, and Fig. 7 shows them as in action. Normally, the cutter A^1 is held inoperative by a catch B^1, which is connected by the lever C^1 and link D^1 to the change-actuating lever M. Thus, the actuating movement of the lever M serves to trip the catch B^1, and the cutter arm E^1 under the influence of the spring F^1 moves into the path of the sley G^1, taking up the position shown by dotted lines. The movement of the sley at the next beat-up serves to operate the cutter.

To avoid the rapid wear of the cutting edges which would be caused by their continuous operation, mechanism is provided to render the cutter inactive after two successive beat-up movements. This mechanism operates as follows:—The rod H^1, connected to the lever M, is slidably mounted in a pivoted bracket J^1, which is oscillated by the cam K^1. The cam rotates at half the speed of the crank shaft driving the sley. When the shuttle-changing mechanism is operated as previously described by the action of the sley through the striker block L on the lever K, the rod H^1 is pulled forward. By the combined forward movement of the rod and the oscillating movement imparted by the cam K^1, a collar L^1 on the rod is carried in a curved path under the stop M^1 fixed to the loom frame and is lifted into engagement with it, as shown in Fig. 7. As the sley moves backwards after the shuttle-changing operation, the rod H^1, by reason of the collar L^1 engaging with the stop, holds the lever M in its forward position and, consequently, the pin N^1 holds the catch B^1 out of action. On the next beat-up the cutter is operated as previously described, the bracket J^1 being still held in its top position. After this beat-up the backward motion of the sley is accompanied by the downward motion of the bracket J^1, the collar L^1 being dropped out of engagement with the stop M^1 and rod H^1 under the action of the spring O^1, resets the levers and catch in the position shown. Should the spring fail fully to reset the change mechanism, a projection, P^1, on the sley sword, engages with the collar L^1 and completes the movement of the rod. The next beat-up operates the cutter as before, but on this occasion the cutter arm E^1, is engaged by the catch B^1, to be held inoperative until the next shuttle change. This mechanism cuts off the weft tails to within a $\frac{1}{4}$in. of the selvedge, and can be adjusted to suit various widths of cloth.

Shuttle-checking Mechanism.

Occasionally, careless operatives place a shuttle in the magazine with its side downwards, and that, by interfering with the correct action of the shuttle-changing mechanism, acts upon the safety apparatus described above, and stops the loom. In the Platt-Toyoda loom, stoppages due to the wrong placing of the shuttles are avoided as follows:—Referring to Fig. 11, which is a section through the magazine, three shuttles A are shown in their correct positions, while A^1 shows a shuttle placed side downwards in the magazine. Fitted in the slot in the back of the magazine are two levers, 1 and 2, pivoted on pins 3 and 4, as shown. By the action of the spring 5 the levers 1 and 2, which are

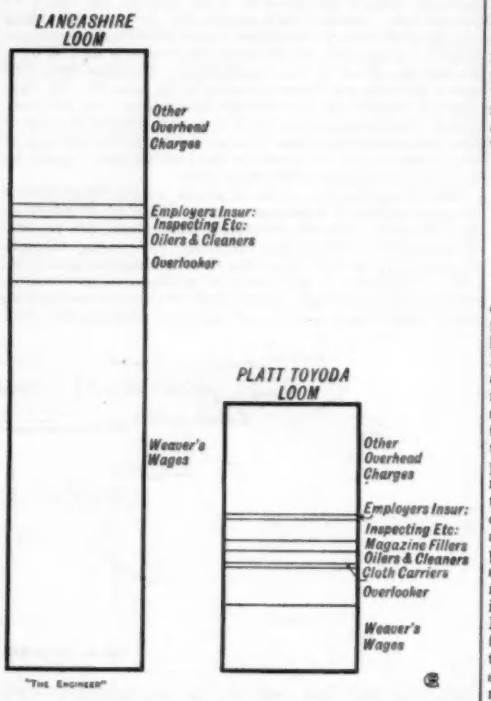


FIG. 12—COMPARATIVE COSTS OF PRODUCTION

in engagement, are pressed inwards into the magazine. In that position the extension 6 on the lever 1 bars the further progress of the shuttle A^1. It should be mentioned that the device is fitted in duplicate near each end of the magazine. On inserting the shuttle in its correct position, the shuttle side presses on the cam-shaped profile of the lever 2, moving it outwards against the pressure of the spring 5 and withdrawing the projection 6 from the magazine, thus allowing the shuttle to pass.

General Construction.

In the construction of this loom rigidity and reliability are features which stand out. Jigs and limit gauges are used throughout its manufacture to ensure interchangeability. Provision is made for the lubrication of all the bearings and for taking up wear, and all the metal parts which come into contact with the warp or cloth are chromium plated. The working speed varies with the

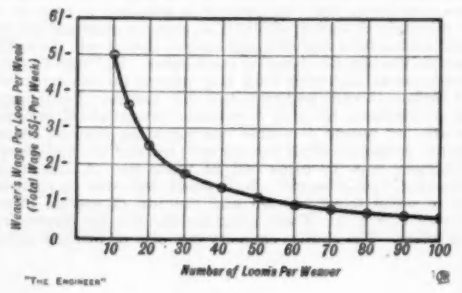


FIG. 13

reed-space and the quality of the cloth being woven, but we are informed that, on average cloths, a loom of 42in. reed-space may be operated at 220 picks per minute, with up to 98 per cent. efficiency. For driving the loom, a $\frac{1}{2}$ horse-power motor is required, but when group driving is resorted to, it is sufficient to allow $\frac{1}{4}$ horse-power per loom.

Automatic *versus* Non-automatic Looms.

The automatic loom is necessarily more expensive than the non-automatic variety, but the makers claim—and the claim is substantiated by a fairly long experience in Japanese mills—that the Platt-Toyoda loom ensures great benefits under almost all practical conditions. For instance, in ascertaining the relative costs of production by various types of loom, it is not sufficient merely to compare the wages bill per loom per week, because more automatic looms can be tended per weaver. There is another important point which enters into the calculations. The number of effective picks per minute is a measure of the productive capacity, and care should be taken to include that factor in making calculations of relative costs of production. As an example, an automatic loom operating at 220 picks per minute with an efficiency of, say, 95 per cent., makes 209 effective picks in that period of time, whereas a loom running at 200 picks with an efficiency of 80 per cent., makes only 160 effective picks per minute. The working costs of the latter are, therefore, more than 30 per cent. higher than those of the automatic loom.

In Fig. 12 two diagrams are given showing the relative costs of an ordinary Lancashire loom and a Platt-Toyoda loom based on calculations carried out by Messrs. Platt Bros. From this figure it will be noticed that there is little room for further reduction under the heading "weavers' wages." The much-discussed question as to the relative numbers of magazine fillers with bobbin and shuttle-changing looms, is also shown in true relationship in the chart. Another interesting chart is given in Fig. 13. This refers to the expenses of production under the heading of weavers' wages, and demonstrates that, above a certain figure, the savings effected by increasing the number of looms per weaver become smaller and smaller, and may be more than discounted by an increase in the delay in attending the causes of stoppages.

This remarkable loom is not an invention of the "mushroom" variety. It is the practical outcome of a long period of development and large-scale trials under normal working conditions, and in the hands of its manufacturers nothing is being spared that can contribute to its successful application to Lancashire's urgent needs for cheapening the production of cotton fabrics.

SIXTY YEARS AGO.

Some interesting side-lights on the early days of railway construction in this and other countries are to be gleaned from the obituary notice of Mr. Brassey, which we published in our issue of December 16th, 1870. Thomas Brassey was born at Boughton, Cheshire, in 1805. He was articled in his youth to a local land agent and surveyor and made an independent start by contracting for the construction of a road in North Wales. In 1836 he signed his first railway contract, for the construction of 10 miles of the Grand Junction line between Birmingham and Liverpool. His next work was the construction of the Penkridge Viaduct on the same line. Thereafter he moved to the South of England and, in association with Mr. Locke, executed large portions of the main South-Western line and many of its branches. In Mr. Locke's company he passed over to the Continent, where he constructed extensive parts of the Western of France and the Paris-Rouen railways. Thereafter he contracted for important works in Belgium, Holland, Denmark, Norway, Spain, Savoy, Italy, and Austria. Many of these works, notably the flying railway over Mont Cenis, proved financially disastrous speculations to Mr. Brassey, but his character was such that he never availed himself of an opportunity of relieving himself of an unprofitable contract and always carried his engagements through to the letter. In the year 1866—a time of financial panic in this country—he was associated with Peto and Betts in the execution of many large works which were paralysed for want of capital. His partners collapsed, but he insisted upon carrying the works through to completion on his own responsibility. Other works with which he was connected were the construction of the Caledonian Railway, the Welwyn Viaduct on the Great Northern, the West London extension line, including a bridge across the Thames at Battersea, the northern mid-level sewer for the Metropolis, and the bridge across the Mersey at Runcorn. Between 1848 and 1861 he either by himself or in association with others undertook the construction of 2374 miles of railway at an aggregate contract price of £27,998,224. In the panic of 1866 he was stated to have lost of his own money over a million pounds. By 1869, however, he was richer than he had ever been at any time in his career. At the time of his death he held several contracts, for he continued in active business right up to the last, chiefly for the sake of the very large staff which he had gathered around him.

INTERNATIONAL ILLUMINATION CONGRESS, 1931.

An International Illumination Congress is being arranged by the National Illumination Committee of Great Britain, in co-operation with the Illuminating Engineering Society. It will be held under the auspices of the International Commission on Illumination, and will take place during September of next year.

The following provisional arrangements have been made:—The meeting will be divided into two parts, the first part consisting of a Congress which will be held from September 2nd to September 12th, and the second part consisting of meetings of the technical committees of the International Commission of Illumination from September 13th to September 19th. Meetings will be held at the following centres in succession:—London, September 1st to 3rd; Glasgow, September 4th and 5th; Edinburgh, September 6th to 8th; Sheffield, September 9th and 10th; and Birmingham, September 11th and 12th. Visits to works will also be paid at each place.

On Sunday, September 13th, a tour by road will be made to Cambridge, where, by the courtesy of the College Council, the delegates will be accommodated at Trinity College, at which the various technical meetings and the plenary session will be held from September 14th to 19th.

The National Committees of the International Commission have been asked to secure papers on the following subjects for discussion at the various sessions:—Factory Lighting, Office Lighting, Home Lighting, Lighting for Aviation, Lighthouses and Buoys, Vehicle Lighting, Street Lighting, Traffic Control Lighting, Flood Lighting, Architectural Lighting, Daylight Illumination, Museum Lighting, Lighting Bureaux, Laboratory Technique, and Lighting of Mines.

The President of the Congress is to be Mr. Clifford C. Paterson, and the Chairman of the General Council, Lieut.-Colonel K. Edgcumbe. Further particulars can be obtained from the Hon. General Secretary, Colonel C. H. S. Evans, the Illuminating Engineering Society, 32, Victoria-street, London, S.W. 1.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

DIVIDING THE CIRCLE.

SIR,—I have recently encountered a problem connected with the dividing of circles which has considerable mathematical interest, and which may have some practical application. It has, very probably, previously been propounded, and solved, although I am not aware of it.

The enclosed sketch represents a master dividing wheel of a type which is in practical use. It will be understood that all we are concerned with is the accurate pitching of the *radial* flanks of the teeth, the other flanks being merely clearance faces. Let the blank be roughed out and let the successive pitches be measured and be found to be p_1, p_2, p_3 . . . p_8. The problem is to determine at which tooth to start the correcting process.

A few trials with a random, but reasonable, series of numbers for the rough pitches will show that any tooth cannot arbitrarily be selected as the starting point of the correcting process. In general, there is only one tooth at which we may start. If we begin at any other we will sooner or later arrive at a pitch the correction of which involves the addition to and not the removal of metal from the adjacent tooth flank. The question is, Which is the correct starting tooth and what is the easiest method of discovering it?

A specific example will illustrate the features of the problem. Let the successive rough pitches of an eight-tooth wheel be as follows:—

p_1	p_2	p_3	p_4	p_5	p_6	p_7	p_8
260	247	252	248	245	255	258	243

The units are of no consequence, but we may take them to be thousandths of an inch.

The arithmetical mean of the rough pitches is 251, and is the pitch which all the teeth should have after they have been corrected.

Let us select the radial flank of tooth 1 as the zero of the correcting process. Passing anticlockwise round the wheel we correct p_1 by removing $260-251=9$ units from the

radial flank of tooth 2. The removal of this metal enlarges p_2 to $247+9=256$ units. We therefore correct p_2 by removing $256-251=5$ units from the flank of tooth 3. The pitch p_3 thereupon becomes $252+5=257$ and is corrected by removing $257-251=6$ units from the flank of tooth 4. The pitch p_4 now becomes $248+6=254$, and we correct it by removing $254-251=3$ units from the flank of tooth 5. When we come to pitch p_5, however, we find that it has become $245+3=248$ units. To correct it we would have to *add* $251-248=3$ units on to the radial flank of tooth 6. The correcting process therefore fails.

We might take the same zero and pass clockwise round the wheel. If we do so, we correct p_8 by taking $251-243=8$ units off the radial flank of tooth 8. The pitch p_7 is thereby diminised to $258-8=250$, and is corrected by taking $251-250=1$ unit off the flank of tooth 7. The pitch p_6 is as a consequence diminished by 1 unit to 254. It is too big to be corrected. It requires for its correction the addition of 3 units to the flank of tooth 6. This is the same result as we arrived at by passing anticlockwise round the wheel.

If each tooth in turn is tried as the starting point, it will be found that the only one which permits us to correct the wheel by the removal of metal and which does not involve the addition of metal to any of the flanks is the sixth tooth. It will be found, too, that the correction will succeed if from the sixth tooth as zero we pass either anticlockwise or clockwise round the wheel.

On the face of things, there is nothing to guide us to select the sixth tooth as the starting point. The pitches p_5 and p_6 preceding and following this tooth are not distinguished for us in any way. They are neither the least nor the greatest of the pitches, nor the nearest to the mean value.

It will be seen that the direct trial and error method of discovering the correct starting tooth is very laborious, even in the case of an eight-tooth wheel. Can any of your readers suggest a simple rule of general applicability which will enable the correct starting tooth to be determined in a direct manner?

I can give a simple rule which enables us to eliminate by inspection certain teeth which must inevitably result in the correcting process failing, if they are taken as the starting point. Passing anticlockwise round the wheel, it is useless to consider as the starting point any tooth which is preceded by a pitch greater than the mean pitch. This rule in the example I have given renders it unnecessary to examine the possibility of beginning with the teeth numbered 2, 4, 7, and 8. The correct tooth, number 6, it will be noted, is included among the survivors, but so also are three others, which on trial are found to be incorrect.

IXION.

London, December 5th.

BRITISH ENGINEERING INDUSTRIES.

SIR,—As an engineer with possibly special opportunities of assessing the nature of the present industrial crisis, both in this country and elsewhere, I feel constrained to enter a plea against the pronouncement of the Engineering and Allied Employers' National Federation on this subject, to which wide publicity has been given in the general Press.

I am basing my remarks on the official *précis* published, but it is, I think, fair to assume that this conveys the considered opinions of the Federation.

It is, I think, increasingly recognised that engineers, as distinguished from pure technicians, are under an obligation to understand the broad principles which govern the relationship between the physical production for which they are responsible and its allocation and distribution to the final purposes of civilisation. The engineers of the United States have set a high standard in the application of engineering methods of analysis to these problems, and it is noticeable that their pronouncements are in the main free from any tendency to favour one side or another of industrial politics.

The communication in question seems to me to depart in two important particulars from this desirable attitude. In the first place, it violates the first canon of technical argument, in using a number of terms, such as "capital" and "industry," which are capable of widely differing meanings, without making any attempt to define them, and, in the second place, it employs phrases of a comparative nature, as, for instance, "production costs are much too high," without indicating the datum of comparison.

I have no means of estimating the nature of the recommendations which will be made by Lord Macmillan's Committee on Finance and Industry, but I feel sure that a perusal of the evidence which that report from its nature must contain, would have been a desirable pre-requisite to the issue of the manifesto in question.

C. H. DOUGLAS.

London, E.C. 4, December 9th.

THE INFERIORITY COMPLEX

SIR,—The letter signed "W. W. S.," which appears in your issue of November 28th, has been brought to my notice.

It is extraordinary how people rush into print without verifying facts.

Over 90 per cent. of gasworks carbonising plant erected in this country during the last ten years has been of original British design and construction. The British carbonising systems have been widely taken up on the Continent, and I can assure you, Sir, as well as "W. W. S." or other doubters, that the British gas plant maker does not suffer from an inferiority complex, but is imbued with confidence in British developments, British methods, and British manufacture.

ARTHUR DUCKHAM.

London, S.W. 1, December 10th.

SIR,—I have only just seen "W. W. S.'s" letter, and wish at once to thank him for it, and you for your excellent leading article.

With regard to gas engineering apparatus, one can speak with some degree of certainty. The fact is that the efficiency of the German carbonising systems is definitely less than that of the leading English systems, and their cost is higher, and the minor advantages claimed for them are not sufficient to explain their adoption. It is to be feared that, just as in the case of the gas holders, novelty is their only attraction. Must we always produce a new thing instead of steadily increasing the efficiency and economy of the old?

CARBONIZER.

December 3rd.

SIDE WIND AND THE RESISTANCE OF TRAINS.

SIR,—Mr. Lindsay, in his interesting letter in your issue of December 5th, asks whether we are to be impressed by the fact that in one case 944 lb. and in the other 16 tons of air are directly affected. I think so, especially when we remember the searching effect of the side wind into all the crevices, to which he refers; and the fact that there is no protective envelope of air.

Taking the case he puts of a side wind of 80 m.p.h. First, he is incorrect in saying that the reaction in the flanges prevents the train being blown to leeward. What does so principally is the friction on the rails. The flanges function just as they do when running in a calm, without any material addition to the total resistance. The flange resistance may be increased by about 50 per cent. on the lee side in extreme cases, with a relief of perhaps 25 per cent. on the windward side to set off against the excess.—See "The Resistance of Express Trains," pages 33 to 35. If the train is moving slowly, as he suggests, so that the resultant is at 89 deg., the formula gives $u=\tan 89=57\cdot29$, so that the speed of the train would be $\frac{80}{57\cdot29}$, or about 1½ miles an hour.

It is putting rather a severe strain on my formulæ for the resistance in oblique winds—which were only put forward tentatively, in the total absence of any observed results—to apply them to such an extreme case, but the result of taking No. 78 on page 39 of my book is to show that the air resistance in these circumstances would be roughly about 900 lb. The question whether this figure would be the same if we pushed the train at 80 miles an hour at 89 deg. to its centre line, requires a wind tunnel to answer; but I think it would be about right. The frontal resistance is, of course, practically nil. Personally, I am of the opinion that the most unfavourable wind of all is one at 45 deg. to the track.

C. F. DENDY MARSHALL.

Wonersh, Guildford, December 8th.

RECENT BUFFER STOP ACCIDENTS AT EUSTON.

SIR,—If these rails on the arrival platforms at Euston had been cleaned of the grease and dirt, and sand put lightly on the rails for the last 100 yards into Euston, these accidents would not have occurred. It is not the drivers that are to blame. That is where the Board of Trade inspector is wrong. Neither the Westinghouse nor automatic vacuum brake will hold a modern train unless this is done. These heavy trains simply skid on a greasy, dirty rail, and no brake will hold them. If the above work is carried out, all that is wanted is buffer planks, which would be quite sufficient without patent buffer stops.

R. AXON.

Manchester, December 6th.

South African Engineering Notes.

Trackless Tram Tests.

CONSIDERABLE public interest has been shown in the road tests which have been recently carried out in Cape Town and elsewhere with trackless trams. The vehicle, which was made by Guy Motors, Ltd., of Wolverhampton, was imported by that company's South Africa representatives for demonstration purposes, which is why it is being placed on the streets of various towns in the Union where tramway systems are in use. It has a wheel base of 16ft. 4½in., with a track of 6ft. 2in. Its overall length is 25ft. 9in. and overall width 7ft. 4½in. The vehicle is designed to operate on a 500-volt supply, and is fitted with regenerative braking. It is of the double-deck type and has accommodation for 59 persons, excluding the driver. Its cost landed, is said to be approximately £3500. Besides Cape Town, Durban, Johannesburg and Bloemfontein are among the towns that are witnessing the demonstration, and may elect to place these trams on some parts, at least, of their systems.

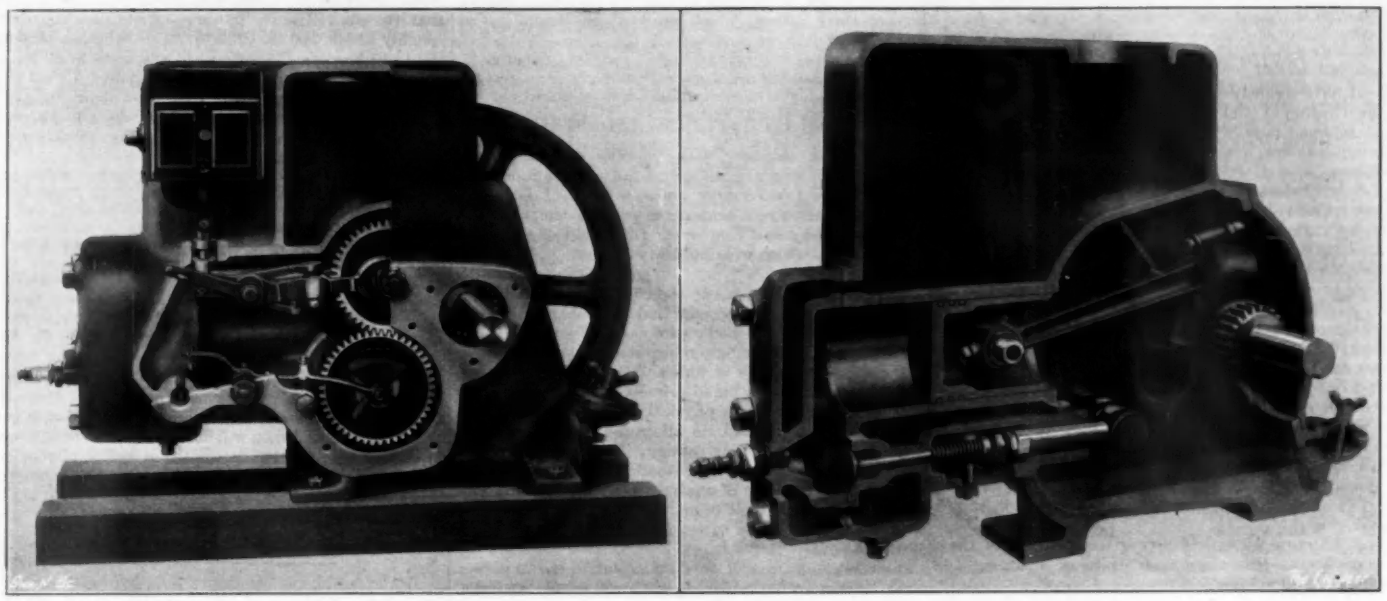
New Air Service.

The Administration of the South-West Africa Mandated Territory has accepted the tender of Messrs. Junkers, of Johannesburg, the South African branch of the German firm, for a combined mail and passenger and freight air service between Windhoek and Kimberley, *vid* Upington and Kaetmanshoop in nine hours. The service is to begin on April 1st next, and will be for a period of five years. The Administration will grant a yearly subsidy of £7000 for the five years. Criticised upon the giving of the contract to a foreign firm, the Administrator has explained that though, nominally, the subsidy asked for was the same in the case of the Junkers tender and that of the Union Airways—there were only two tenders—Junkers were prepared to carry the mail at 25 per cent. cheaper than the Union Airways. Junkers also offered that should the mail exceed a certain weight, namely, 6000 lb., the Administration would receive a rebate of 50 per cent. on the amount exceeding that figure. The amount, however, of the rebate in any year is not to exceed the subsidy for that year. There is no doubt that Junkers have been more concerned in making this contract to get their "foot in" than anything else, as the mail matter from such a sparsely populated country as South-West Africa can only be small, especially as the service terminates at Kimberley in the Union. It will give them better standing regarding contracts for other new routes, and it is also a fact that the contract which Union Airways has, to carry the mails between Cape Town, Port Elizabeth, Johannesburg and Durban, will terminate in another two years.

Mineral Production in South Africa.

For the nine months ended September 30th the value of the mineral output of the Union, excluding diamonds, was £37,820,183, compared with £37,613,882 for the corresponding period of 1929. Gold showed an increase of about £787,000, but coal and most other minerals and metals had decreases, so that the total increase for the nine months was only just over £200,000. The following are the main items, with the amounts for the corresponding period of last year in brackets:—Gold £34,013,285 (£33,226,686); silver, £63,834 (£87,906); osmeridium, £51,432 (£69,574); platinum, £80,196 (£136,739); coal, £2,686,010 (£2,871,391); copper ore, £433,223 (£525,337); tin concentrates, £104,542 (£187,289). Other minerals: Asbestos, chrome, arsenic, mica, &c., £387,611 (£506,913). The total value of the mineral production of Southern Rhodesia for the nine months ended September 30th, 1930, was £3,285,574, a decrease of £86,118 compared with the corresponding period of 1929. Mica is the only important mineral to show an increase in production. The Union Mining Department no longer publishes the figures of the production of diamonds, but, according to the export figures up to the end of July, 1930, beyond which no details are as yet published, the value of the diamonds exported up to then was £3,889,789, compared with £6,137,506 for the corresponding period of 1929. These totals include raw diamonds and the cut and polished diamonds.

EXHIBITS AT THE SMITHFIELD CLUB SHOW



HOPPER-COOLED PETROL ENGINE—RUSTON AND HORNSBY

The Smithfield Club Show.

GENERALLY speaking, the annual Show of the Smithfield Club, which has been held during this week, is, nowadays, disappointing from the engineering point of view. There is such a stereotyped style

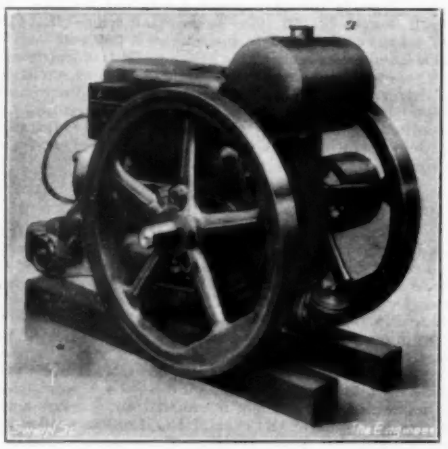


FIG. 1—PETROL ENGINE—RUSTON

of manufacture in the machinery exhibited that one might almost assume that finality had been reached. But we cannot believe that this is really the case, and we do believe that with the real co-operation of the agriculturist, the chemist and the engineer much more could be brought out of our land than is at present achieved.

However, our concern at the moment is to give some idea as to the machines which were shown at the Agricultural Hall, Islington. There were many familiar exhibits and several absentees, so we take, on adjacent stands, and among the former there was a new engine, which we illustrate in Fig. 1, and above. As will be gathered from these pictures, it is quite a small machine, ranging in power from 1½ H.P. up to 6½ H.P., and is of the hopper-cooled type. The

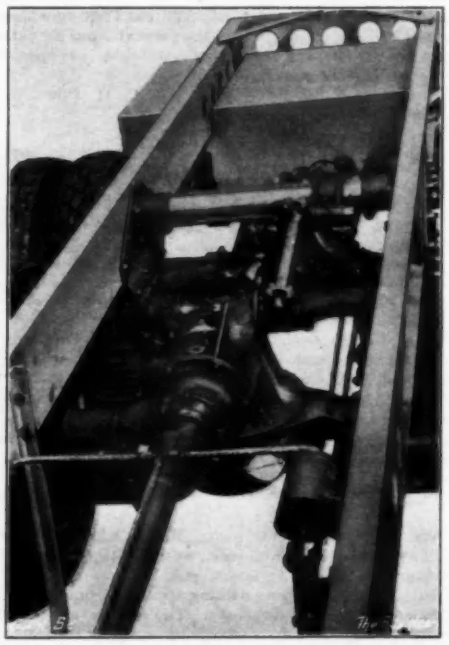


FIG. 3—TRANSMISSION GEAR—FODENS

cooling arrangements can, of course, be rearranged for an outside tank by the affixing of a lid and piping to the opening on the top of the hopper. A peculiar

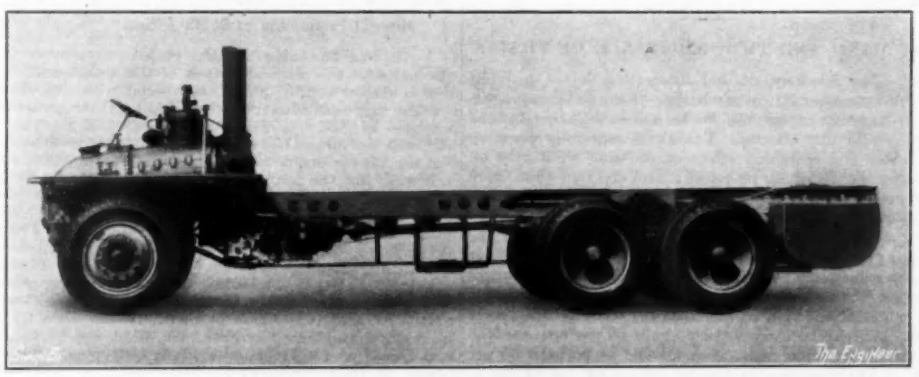


FIG. 2—SIX-WHEEL STEAM WAGON—FODENS

at random, a few examples for the illustration of the direction which development is taking.

Ruston and Hornsby, Ltd., of Lincoln, had the usual display of engines and agricultural machinery feature of the engine is that it is so completely enclosed that it can be run in such conditions as those of a chaff-cutting barn, where the atmosphere is heavily laden with dust. The valve gear, the magneto and other parts are all fully enclosed. It is hardly necessary to enlarge upon the constructional details of these engines here, as they are well demonstrated in our illustrations.

One of the new styles of steam wagon was that of Fodens Ltd., of Sandbach, Cheshire, which is illustrated by Figs. 2 and 3. As will be seen from these views, the vehicle has four driving wheels, which are driven by a two-cylinder engine of 5in. bore by 7in. stroke, arranged transversely across the frame, so that the valves and other parts are readily accessible for overhaul. The valves are of the poppet type and are actuated by cams. There is a two-speed gear-box incorporated in the crank case, which transmits the power through a cardan shaft to the worm-driven axles. Each of these axles has, of course, its own differential gear, and there is also a differential gear between the front and back driving axles, as can be seen in Fig. 3. The gear ratios are said to enable the vehicle to climb gradients of 1 in 3½ when

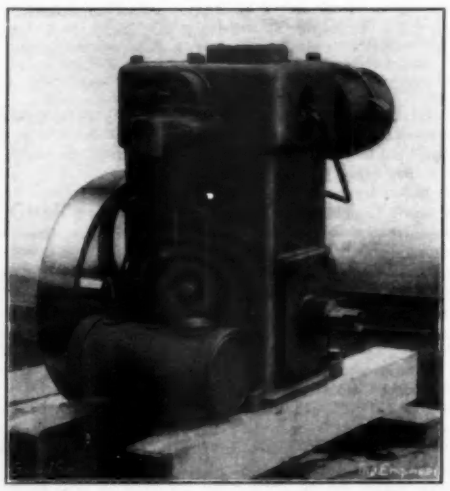


FIG. 4—1½ H.P. PETROL ENGINE—BLACKSTONE

fully loaded and to attain road speeds of 45 miles per hour. The boiler is of a new design with a dropped fire-box of circular construction and water tubes, which obviates all internal stays. The boiler is set low in the frames and, as a consequence, firing is effected through a short taper shoot in the top of the fire-box. The working pressure is 275 lb. per square inch. The chimney, it will be seen, is at the rear end of the boiler, so that the driver has an unobstructed view. There is a dual system of water feed, one by means of an injector and the other by a pump driven off the engine. The wheels are of the disc type, on roller bearings, and are all fitted with pneumatic tires.

The little petrol engine illustrated by Fig. 4 is one of a new design brought out by Blackstone and Co., of Stamford, which is being made in several sizes ranging up to 7 B.H.P., when running on petrol, or 6 B.H.P. on paraffin. It has overhead valves and a governor on the carburetter, which regulates both the quantity and the quality of the mixture, according

to the demands upon the engine. The cylinder is fitted with a detachable head, so that it can be easily opened up for de-carbonising or general cleaning. The speed of these engines ranges from 1200 revolutions per minute in the smallest size to 585 revolutions in the 7 H.P. size.

We have, in the past, referred to the McLaren-Benz oil engine and its application to agricultural work, and it appeared in such form at the Show. We learned, however, of a new development in its use for canal towing work. There has recently been put into service in Leeds a barge of 130 tons dead-weight capacity equipped with a 90 H.P. engine of this type, and it has proved itself to be most efficient. During some official trials the barge made a speed of 7½ knots with a fuel consumption of 2·8 gallons of crude oil per hour. At another time she made a voyage from Leeds to Hull, Goole and back, with a total freight, including tows, ranging up to 440 tons on a total consumption of 126 gallons of oil for the round journey.

The most novel exhibit on the stand of Marshall, Sons and Co., Ltd., Gainsborough, was the oil engine agricultural tractor which we illustrated in our issue of July 4th last. In the circumstances it is hardly necessary to give many particulars of its construction, but it may be mentioned that it is equipped with a single-cylinder horizontal two-stroke cold-starting engine of about 30 brake horse-power. This engine has a cylinder 8in. bore by 10½in. stroke, and runs at 550 revolutions per minute. An air filter, which we noticed is becoming common in agricultural tractors, is fitted on the induction pipe. This machine is said to give a tractive effort of some 3500 lb. when working in low gear.

There was another tractor on the stand of Richard Garrett and Sons, Ltd., of Leiston, equipped with a four-cylinder crude oil engine, by Aveling and Porter, but it was noticeable that the old style of traction engine, or its more modern development—the steam tractor—was not so fully represented as has been the case in the past, although there were still Wm. Foster and Co., of Lincoln, and Wallis and Steevens, of Basingstoke, but no Aveling, Burrell, Fowler, Garrett, Marshall, or other familiar steam traction engines were to be seen.

FELLING A DAM IN CANADA.

IN the process of developing the Saguenay River, at Chute-a-Caron, about 140 miles north of Quebec, it was necessary to divert the flow through an artificial cut while the main dam was built. This cut had, of course, subsequently to be closed, and the expedient adopted was to build a closing dam in a vertical direction to completion, and then to topple it over into the channel. The idea is not altogether novel, having been used on the river Euphrates and other places, but the Canadian example is interesting.

The river has a flow varying from 35,000 to 225,000 cusecs, and this flow was passed through a channel, which, we should judge from pictures in *Canada*, to be about 100ft. wide.

For the purpose of closing this cut, when the main dam had been completed, an obelisk of reinforced concrete was built upon one bank. Its contour facing the stream was made to conform with that of the cut bottom, so that it had a sort of pot-bellied form. It was 92ft. high by 45ft. by 45ft., and contained 5500 cubic yards of concrete. The obelisk was built on the top of a low pier made in two pieces, so that the riverside part could be blasted away and leave the obelisk to hinge over into the water. When the obelisk was felled, water was thrown 200ft. or 300ft. in all directions, but the mass of concrete took up the desired position despite the swift current in the channel. Sealing operations were completed in four days.

THE report of the Automatic Train Control Committee contains some interesting signal statistics. Taking the four grouped companies in the following order—Great Western, Southern, London, Midland and Scottish, and London and North-Eastern—the number of signal-boxes on those lines is 1364, 1107, 4265 and 2677 respectively; the number of distant signals is 3406, 2831, 11,722 and 6715; of stop signals, 8050, 6861, 22,778 and 17,431.

Single-phase Repulsion Start Induction Motors.

THE principle of starting single-phase motors as repulsion machines and then causing them automatically to convert themselves into induction motors is not by any means new, but, in the past, machines of this type have been manufactured mainly abroad. At Higgs Motor Works, Witton, Birmingham, however, these motors have been made for a considerable time, and during a recent visit to these works a considerable number were brought to our notice. They have been designed to meet the demand for a silent single-phase motor with high starting torque, and are claimed to be well suited for driving domestic machines in private houses, for blowing church organs or for any purpose that calls for a high starting torque and silent operation. For the benefit of our readers who are unfamiliar with the general principle we should explain that, attached to the armature, is a centrifugal governor—shown at A in Fig. 3—whilst at the opposite end there is a radial commutator, as shown at A, Fig. 4. The sleeve B and shorting lace C, shown in this illustration removed from their working position, are free to move inside the commutator parallel to the shaft, and when the motor has attained a predetermined speed the governor opens out, and by means of the internal push-rods D forces the sleeve and the lace forward, the function of the lace C, which is held in position by centrifugal force, being to short-circuit the commutator bars. At the same time, the toggle washer E—Fig. 4—is forced into the centre of the end cover and lifts the four toggle levers A—Fig. 5—thus removing the pressure from the brushes. A section through the motor showing the short-circuiting mechanism is given in Fig. 1. When current is supplied to the machine by means of an ordinary knife switch, it starts as a repulsion motor, as the shorting lace C is clear of the commutator; but after the governor operates at a predetermined speed, the commutator is short-circuited and the brushes are lifted. The machine then runs as an induction motor, but when it comes to rest the governor operates in the reverse manner to that described, and makes it ready for starting as a repulsion motor.

The bushes are composed of chilled cast phosphor bronze, and are lubricated by means of wool yarn, a considerable quantity of which is inserted in each of the bearing housings.

The machines can be thrown directly on to the line by means of a double-pole switch, when they will develop a starting torque of approximately 3 to 3½ times full load torque, and take approximately twice full load current from the line. They can, however, be used with starters designed to pass full load current on the first stud, when the machines will develop a starting torque of 1 to 1½ full load torque, which increases as the starting handle is moved over the remaining studs. The machines are arranged to run in a horizontal position, and in the event of it being necessary to fix them to a wall or ceiling, the end covers can be rotated. Efficiency and power factor curves for a 1 horse-power machine are given in Fig. 2.

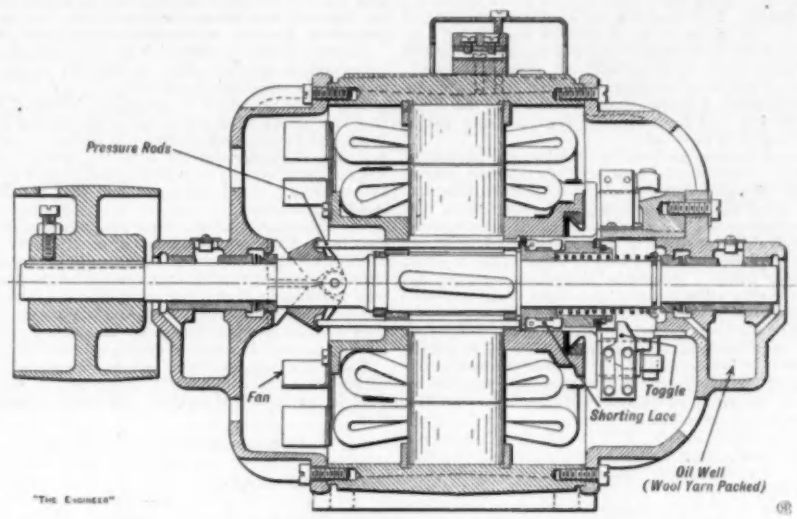


FIG. 1—SECTION THROUGH MOTOR

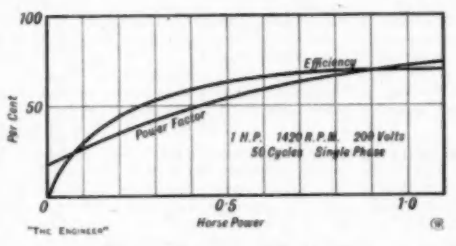
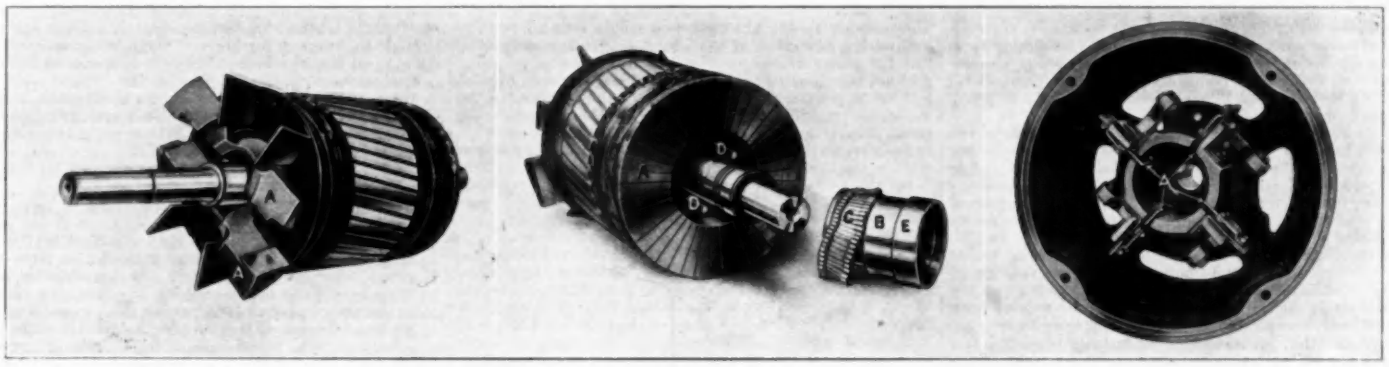


FIG. 2—PERFORMANCE CURVES



FIGS. 3 TO 5—ARMATURE AND END COVER

Russian Railway Equipment.

(By a Correspondent.)

AMONG the many problems confronting the Soviet authorities at the present time one of the most important relates to the reconstruction or renewal of the railways, and the establishment of new lines. But a great difficulty lies in the shortage of steel products for railways and for the provision of locomotives and rolling stock. Although matters are declared by Soviet organs to be improving, a long time must elapse before anything like a normal state of affairs can be restored.

In the case of rails, the official organ of the Commissariat of Ways and Communications—*Ekon. Sjisn*—recently recalled the fact that in 1913 the railways consumed 660,000 tons of rails. In 1926–27 the quantity used was 227,000 tons; in 1927–28, 281,000 tons, and in 1928–29, 300,000 tons. From these figures it will be seen that the railways are getting considerably less tonnage than in the pre-war period. During the nine months ended with last June, six works, which are mentioned, were to have supplied 389,000 tons of rails, but by that date only 270,000 tons had been delivered. There is nothing to show that the deficiency has yet been made up, or that the tonnage needed in the subsequent three months which completed the financial year 1929–30 has been supplied in full. The lack of sufficient rails is causing delays not only in the laying of new lines, but also has arrested or delayed the renewal of the tracks on the principal lines. Moreover, the rails delivered are far from being perfect, judging from an illustration representing a photograph of the fracture of absolutely new rails which was published in the Moscow organ a few weeks ago. The situation is no better as regards the supply of rail fastenings.

It is calculated that a total of 2,475,000 tons of steel will be required in 1931 for the needs of the railways. This tonnage includes materials needed by the locomotive and wagon works, of which most are vested in a combination known as the Parvagdiz—Locomotive-Wagon Diesel Engine Union—which is claimed to represent one-third of the engineering capacity of Russia and to employ over

100,000 men. On this combination depends substantially the question of the improvement of rail transport. The combination is expected to turn out in 1931 products of the value of 700 million roubles, including 1150 locomotives, 4300 wagons and Diesel engines representing 123,000 H.P. In the political year 1929–30, which has just expired, the combination is said to have manufactured products of the estimated value of 338 million roubles, or 50 per cent. more than in the preceding year.

Although the production of iron and steel at the Soviet works is reported to have increased in the year ended with September, 1930, the actual figures are, apparently, not yet available. But new iron and steel works are stated to be in course of erection in various parts, and the fantastic figures of 17,000,000 tons of pig iron are mentioned as the possible total output in 1932–33. For the present, however, there is a keen shortage of iron and steel materials and a general hunt is being made to collect all the scrap iron and steel in the country, it being said that not a hundredweight is to be missed.

The general position in regard to production, no matter what particular industry is concerned, is that the output possibilities of any industry, works or group of works, are taken at an exaggerated value, and, based upon this erroneous assumption, programmes of production are set which it is truly impossible to fulfil, leaving entirely out of account the effect of the human element in the matter. On the latter point it should be stated that during the past few months efforts have been made and are still being made to stimulate production at different works by the introduction of what are termed "fighting brigades" of workmen, by the inculcation of a system of emulation as between different works producing the same class of products, and in the past two months by promises of the grant of premiums for efficiency. The provisional results of all these efforts are that work is now being rushed through as fast as possible, as is shown, for instance, by the November reports of the few number of hours now being occupied upon the general repair of locomotives. Time alone, however, will prove the value or prejudice caused by this hustling.

The above observations will, naturally, explain the backwardness in the deliveries of iron and steel and engineering products in the past twelve months. The works are being called upon to perform the impossible; they are blamed for not doing the impossible, and those who are directly responsible are not infrequently threatened with prosecution, to use a mild term. Predictions are certainly out of place on this question, but it is quite obvious from the above extracts from the organ of the Commissariat of Transport that matters are not proceeding in such a rosy manner as Soviet leaders from time to time assert. Even the much vaunted Turkestan-Siberian railway, which was ceremoniously opened a few months ago with a train travelling at 4 miles an hour, has yet to be completed and the temporary track converted into a practical working line.

The Failure of Flat Bottom Steel Rails.

By A. H. HUDDART, Works Manager, Egyptian State Railways.

THE failure by fracture of a large number of steel rails of the flat-bottom type, 95 lb. per yard, forming a portion of a supply of some 25,000 tons from the same rolling mill to the Egyptian State Railways, caused the writer, some eighteen months ago, to pursue investigations, the result of which is given herein. The rails under consideration were delivered in Egypt, manufactured in accordance with B.S. Specification No. 11, 1926, Egyptian State Railways Specification, and B.S. Specification No. 11, 1922, and in all cases the failures occurred after delivery in the country, within twelve months of the date of rolling. The fractures developed either in the track or during unloading on site.

This type of rail having been subject to failure in various parts of the world and having originated from various rolling mills, some considerable investigation has resulted by different authorities, and in many instances a flaw on the surface of the fractured rail was observed, which appeared as a straight horizontal line in bas relief on one side of the web only, appearing intermittently on the rail length at the upper terminus of the radius between the web and the bottom flange, approximately at a height of 1in. from the bottom of the rail; henceforward in these notes it is referred to as the lap. When such lap occurred and the rail fractured in handling or whilst in the track, the fracture was along the line of the lap, and a paper published by the Government of India under title "Hammer Tests on Rails" is a statement of a thorough investigation into the effect of this flaw or lap upon rails in a certain structural condition.

The lap is produced in the final "passes" at the mill and can be avoided by suitable machining of the rolls combined with correct reduction of section at each "pass," but since the failures which have occurred on various railways always originated in consignments in which this flaw was visible, it has been considered that the lap was the cause of fracture.

The inference that the writer draws from his investigation is that the lap has little or no effect on a rail in a "normal" state of structure, which inference is strengthened by the fact that in many rails, self-fractured, no lap was visible and that a further 5000 tons of rails without lap, produced at a date later to the origin of this investigation and in another European country, for delivery to Egypt, produced a higher percentage of fractures.

The tests were carried out by means of a Herbert pendulum tester on the one hand and a Wild Barfield electric furnace on the other, the hardness number being obtained by timing the first two single swings, thereby minimising any effect of work hardening. The sections of rail for test were ground and polished on a precision grinder, and ten tests were taken over the face of each section in positions approximating to those shown in the accompanying diagram, an average of the ten tests being taken in each instance for the tabulated comparisons.

No increased or reduced hardness could be detected at or around the lap, but because it was found that extremely wide readings in the average hardness number were obtained from different rails rolled at the same mill, to the same specifications, under the same contract and giving almost identical chemical analyses, it was considered that some external factor was influencing the conditions of the rails; hence the writer decided to "normalise" the test sections by heat treatment. The opinion being that the steel had been "chilled" on leaving the mill, further indications had been obtained that such chill might exist, as some sections had been found to have the flange much harder than the head as would occur if the finished rail was placed, when hot, on a cold wet surface; also that, in some instances, one hand of the section considered from the vertical axis showed, on the other hand, head, web and flange a harder structure, as would occur if the rail was subjected to a cold side wind with rain during cooling. From this theory would arise the inference that steel so constituted as to be subject to "chilling" in the manner indicated would be liable to fracture when rolled with a lap, and would be comparable with the friability of a glass pane scratched with a diamond.

The summarised data which is given below represents the tests on more than 100 different sections of rails, all of which tend to confirm the writer in the opinion that "chilling" in rails containing a relatively high percentage of manganese and carbon is the cause of fracture, leading to the theory that by controlling the rate of cooling, after the rail leaves the mill, an ideal combination of hardness and strength can be obtained. Unfortunately time has not yet been available to develop tests in this direction.

It may be observed, in passing, that sections showing lap as represented by test series No. 12, after heat treatment, withstand bending on the vertical axis similar to the section of a sound rail, *i.e.*, fracture at the lap does not occur.

It appears conclusive that a perfectly sound rail to give good track service will always show a degree of hardness in the "as rolled" state markedly in excess of that in the "normalised" state, and so long as this difference in hardness is within the known limit the rail may be employed with confidence.

Concluding, the writer desires to express the opinion that the tests herein represented have not been sufficiently exhaustive to produce final definite conclusions on the effect of the influence of the many factors governing the manufacture of satisfactory rails of high carbon content, and submits that the investigation has been extensive enough to warrant further and complete research being made upon the lines indicated by the inference to be drawn from the foregoing.

Acknowledgment is due to Mr. R. E. Thomas, Deputy Chief Engineer, Egyptian State Railways, by the writer, for the ready assistance and facilities given in the collection of the foregoing data.

Results of the Summary of the Tests.

Rolling mill.	Process.	Year rolled.	Test series No.	Behaviour in service.	Typical works tests. Analysis. Mg.	C.	Si.	P.	S.	Tensile. Tons per sq. in.	Elongation %	Brinell No.	Pendulum hardness No. (average). (1) As rolled.	Brinell equivalent.	(2) After normalising.	Brinell equivalent.	(3) Reduction obtained Brinell Nos.	Remarks.
A. (G.K.N.)	Bessemer acid	1926–27	1	Split at lap	0·80	0·47	0·12	0·063	0·059	47	19	—	33·8	383	26·0	223	115	This represents the hardest rail found from this mill
			2	Ditto									27·8	256	25·4	212	44	—
			3	Satisfactory but lapped									24·8	203	23·5	182	21	Represents softest rail found from this mill
	Ditto	1928–29	4	No lap, but broke in track	0·79	0·48	0·18	0·058	0·045	50	14	180–210	28·0	260	23·4*	180	80	Supplied as replacement from previous failures
			5	Ditto									27·8	256	22·2*	160	96	Ditto
			6	Ditto									27·8	256	22·5*	167	89	Ditto
B. (De W.)	Siemens Martin open-hearth basic	1928–29	7	No lap, broke in track	0·83	0·62	0·13	0·045	0·036	56	16	—	27·5	250	24·3	194	56	Representing a consignment rejected after delivery
			8	Ditto									27·5	250	23·6	182	68	
			9	Ditto									27·5	250	24·2	194	56	
C. (B.V.)	Ditto	1926–27	10	Burred over at joint after 18 months in track	0·83	0·60	0·11	0·035	0·031	50	18	—	26·1	225	22·0*	160	65	Represents a rail high in Mg (0·966), yet easily worn in track
D. (Bar)	Open-hearth acid	1926–27	11	Satisfactory ..	0·80	0·58	0·16	0·051	0·055	52	16	—	24·1	194	21·2*	150	44	Representing very satisfactory rails
E. (Work)	Bessemer acid	1928–29	12	Satisfactory ..	0·82	0·50	0·19	0·042	0·030	50	17	206	25·7	218	24·0	190	28	Ditto

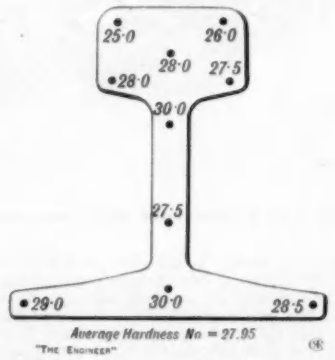
N.B.—The conversion of the hardness number to Brinell No. is obtained by the formula $T^2 \times 0{\cdot}33 =$ Brinell No., where T is the pendulum hardness number. This was found to give close approximation within the range of the steel under review.

The normalised hardness numbers where marked thus * were obtained after increasing the normalising temperature, which accounts for the increased softening. The change in the temperature was made solely to ascertain whether the critical normalising temperature had been reached, and the results showed that the previous temperature employed was below the critical point.

A survey of the above table shows that—

(*a*) "Normalising" gives similar results upon rail sections of similar manufacturing process:—
For Bessemer acid—Mill A test series No. 3 and Mill E test series No. 12. For open-hearth basic—Mill B test series No. 8 and Mill C test series No. 10.

(*b*) The inference from "normalising" is that by controlling the rate of cooling, any desired rail hardness within ascertainable limits can be obtained. Rail group tests Nos. 1 to 6, in particular Nos. 3 and 4, both before and after normalising.



STEEL ARCH 1652FT. SPAN.

THE steel arch span of the Kill van Kull bridge connecting the mainland with Staten Island, in New York Harbour, was closed in October. It has a rise of about 260ft. and will be intersected by a roadway suspended from the arch at about 150ft. above the water. The span is 1652ft. between centres of pins, or 2ft. more than the great bridge over Sydney Harbour, in Australia. Both bridges have the arch of two-hinged type, and both will carry roadways and railway lines. As the water of the Kill van Kull channel is comparatively shallow and quiet, the scheme of erection was to support the arch by a succession of temporary steel piers, building it out by cantilevering beyond each pier, a traveller riding on the upper chord or boom to place the material. A curious feature was that the closure was not made at the crown or centre of the arch, but at a point nearly 250ft. from it. This was due to the fact that the deeper ship channel is near the south shore and no falsework could be permitted in that channel. As each temporary pier was completed, jacks at its head or base raised the arch slightly so as to take the load from the preceding pier, which was then dismantled. A toggle truss mounted on the upper boom directly over the last temporary pier for the longer side of the span, relieved the stresses in the arch members adjacent to this pier and transferred them back to the shoreward portion of the arch. At the closure, a 16in. pin bearing in the lower boom facilitated bringing the two ends together, but after erection this joint was finished with riveted connections. Both silicon steel and carbon-manganese steel plates were used, with carbon-manganese steel rivets.

Railway and Road Matters.

THE Institution of Railway Signal Engineers has now completed its arrangements for students of the Institution to enjoy the benefit of the £1000 left by Mr. W. J. Thorrowgood to found a Thorrowgood Scholarship. It is hoped that the first candidate will commence his studies at the opening of the autumn session of an approved technical college next year.

THOSE passengers who, regularly or occasionally, travel to the City from Waterloo by the Waterloo and City Railway, and when ascending or descending the approach to the City station, have had unkind thoughts for the Southern Railway for its failure to provide an escalator, will be glad to know that powers are being sought in the present Session towards that end.

IN a paper on "Chemistry in the Service of the Railway," read by Dr. Lewis Dale, of the London, Midland and Scottish Railway, before the Liverpool local sections of the Society of Chemical Industry and the Institute of Chemistry, the author said that the first railway chemical laboratory was that at Crewe, opened in 1864. Dr. Dale claimed that the London and North-Western Railway was a pioneer in the application of chemistry to industries other than the chemical industry itself.

THE general managers of the railway companies met the representatives of the three railwaymen's unions on Wednesday to discuss the reductions in wages and changes in the conditions of service proposed by the companies and the counter proposals of the men. It was a foregone conclusion that agreement would not be arrived at and that the matter must come before the Central Wages Board, and, most likely, be referred to the National Wages Board. In view of the nearness to the Christmas and New Year holidays, any further consideration is impracticable until January.

UNIFORMITY of policy on the railways of the various states of Australia and of the Commonwealth is likely to result from a proposed conference of all the State Railway Commissioners. It is intended that the Commissioners shall consider: (1) consolidation and control of all the Australian railways; (2) capitalisation; (3) obsolescence and depreciation; (4) separation of railway from the general finances; (5) co-ordination of the various forms of transport; (6) non-paying lines; (7) standardisation; (8) freights and fares; (9) a railway clearing house; (10) a uniform policy facilitating ultimate gauge conversion.

JUDGING by the Parliamentary Notices for the session of 1931, the Great Western Railway proposes to eliminate, or at all events to control, the privately owned wagon on that system. As the exact wording of this intimation is of interest, we reproduce it, as follows:—To empower the company and any other company body or person owning or hiring railway wagons for the conveyance of mineral traffic to enter into and carry into effect agreements for the acquisition control interchangeability and common user of wagons of that description or for any of such purposes and to (*a*) subscribe to the capital of any company or companies which may be incorporated for all or any of such purposes (*b*) hold stocks shares and securities of such company or companies and (*c*) guarantee the dividend or interest on such stocks shares or securities.

ACCORDING to the Railway Returns for 1929, there is a great contrast between the "other" mileage of the engines of the London, Midland and Scottish and of the London and North-Eastern Railways. The passenger trains on the former line required, and had, assisting engines for 1·72 miles for each 100 train miles, and the L. and N.E. had 1·18; but the L.M.S. had assistance when not required for 1·36 miles to 100 passenger train miles, as against 0·24 miles per 100 for the L. and N.E. In freight traffic the contrast was much greater, as assisting when required was 6·04, against 2·33, and assisting when not required 0·94 as compared with 0·19. The mileage of light engines was about the same. The L.M.S. had 6·19 for passenger and 12·26 for freight, whilst the L. and N.E. had 5·40 and 11·97 respectively. The London, Midland and Scottish was the most expensive in shunting for passenger traffic. Its proportion per 100 train miles was 8·99, as compared with the L. and N.E., 6·46; Great Western, 6·80, and Southern, 7·92. It was the best, though, as regards freight train shunting, as for that the figure was 71·16, which compared with 74·07, 87·53 and 97·96 of the other three companies.

THE causes of derailments are often hard to determine. Factors of speed, state of the track and condition and behaviour of the locomotive and rolling stock enter into the question at times. The cause of collisions, on the other hand, are, as a rule, readily found. The responsibility generally lies between the driver and the signalman, with, occasionally, hard swearing between two signalmen. The derailment of the leading bogie of the rear coach but one of the 10 a.m. "Flying Scotsman" from King's Cross on June 30th was illustrative of what we have said above. The derailment occurred 1½ miles south of Beal at a point where the road had been ballasted with ashes; but stone ballasting operations had been in hand since March. Approaching the point of derailment the sleepers were wholly exposed and a speed restriction of 20 miles per hour was called for. Various causes for the accident were considered, but the opinion formed by Colonel Mount, who inquired into the accident and whose report was issued on December 5th, is that the driver did not reduce his speed sufficiently, with the result that the track was forced out of alignment. Included in that officer's conclusions is the suggestion that when speed has to be reduced over a long length of line—as was the case in this instance—there should be a time limit for passing through the area and not a speed limit. The distance of the operations in question was 1½ miles, and Colonel Mount concludes his report by observing that "operations, such as were being undertaken, particularly on a main line, should be carried out to a systematic and progressive programme, with proper co-ordination of the supply of ballast and labour available. Otherwise, it must become difficult to ensure that disturbance is confined within reasonable limits and that the track, however substantial it may be, is not subjected to heavy traffic for longer than is absolutely necessary while in an open or unfinished condition."

Notes and Memoranda.

THE wreck of the s.s. "Cariboo," which sank off East London, has been so broken up by heavy weather that further attempts to salve her £30,000 cargo of copper have been abandoned.

THE whaling fleet which recently left Cape Town for the Antarctic, after refitting there, was the largest ever seen in the harbour. It comprised twelve factory ships and fifty whale catchers. During last season over two and a-half million barrels of oil were obtained, an increase of 55 per cent. over the previous season's catch.

GENERALLY speaking, states the author of a paper on the economic application of electricity to space heating, electric heating is an economic proposition when the tariff is ¾d. per unit or under and the comparative cost of fuel is 30s. per ton. These values are applicable to normal day heating and may be considered as average values for the class of work.

AT a recent meeting of the Junior Institution of Engineers, Mr. G. H. Willett stated that it was possible at the present time to take a photograph with an exposure of one ten-millionth part of a second; the aerial photographer could take photographs of mist covered ground in such a way that the mist was entirely eliminated and by using ultra-violet rays it was possible to magnify a photograph up to 14,000 diameters. The chemist and the instrument maker had collaborated in these advances.

A NEW form of reflector has recently been evolved for use in hospitals and operating theatres, where it is most desirable to have even illumination without any shadows. A complex reflecting system is employed, the light being reflected upwards on to a conical mirror. From here it is reflected almost horizontally to a second series of mirrors, distributed around the periphery of the housing. These are set at the appropriate angle, with the result that the light is concentrated over a relatively small area immediately under the lamp. It is claimed that with this system of lighting no shadows are cast, even if the surgeon places his head in between the lamp and the operating table.

AN unusual case of boiler explosion is recounted in one of the latest official reports. It is that of the safety valve fitting of a Scottish hopper barge. The boiler appears to have been about twenty-eight years old, although the vessel was built in 1864. The safety valve blew off under a pressure of about 30 lb. per square inch, and two men were rather badly scalded. It was discovered that four of the set screws used to hold the valve to the steam dome had been fractured for some time, and ultimately the remaining two failed. Their failure is attributed to a very small leak of steam, which was not visible, but was sufficient to moisten the joint and produce rust. The expansion of volume in the production of the rust was sufficient to break the screws.

To maintain comfortable temperature and cleanliness in railway cars during the summer, when travel is often attended with discomfort owing to heat, dust and smoke, both the Baltimore and Ohio and the Atchison, Topeka and Santa Fé Railways are experimenting with an air-conditioning system which cools and cleans the air supply. Each system has a dining car thus equipped. Air drawn from the interior of the car and supplemented by outside air is passed through filters and cooling coils and then distributed through ducts to openings along the sides of the monitor roofs. The car windows are kept closed and the doors are opened only as persons pass in and out. The apparatus is under the control of the car conductor or steward, and is able to deal promptly with special conditions, such as the entrance of smoke when passing through tunnels. In a hot-weather test on the Baltimore and Ohio the interior temperature of 93 deg. was reduced to 70 deg. in 20 minutes after the apparatus had been put into service.

THE apparatus usually employed to produce liquid hydrogen is elaborate and costly, with the result that it is available for low-temperature researches in very few laboratories, although quite small quantities of liquid would often suffice. A small and inexpensive liquefier is described in *Nature*. It can be assembled in a few days by any laboratory workshop. It operates on the Linde principle, hydrogen drawn at high pressure from a cylinder, after purification, being first circulated through a tube immersed in liquid air, and then subjected to valve expansion with regenerative cooling in the usual way. The main part of the system is supported in a Dewar flask. The temperature of liquid hydrogen—20 deg. absolute—is attained in from 5 to 8 minutes, with an initial pressure of rather more than 100 atmospheres, and a flow of a few litres per second, whilst liquid helium can be equally readily produced if liquid hydrogen is available in quantity. The use of the apparatus is obviously limited by the small volume of the vessel into which the valve opens, but, with this restriction, it makes the production of very low temperatures feasible in any place when liquid air can be obtained.

A MESSAGE from Stockholm states that trials have been going on for some time at the Sandviken ironworks with a new method for the plating of iron with aluminium, and they are said to have been so successful that the works have acquired the right to exploit the new invention in Sweden, Denmark, Norway, and Finland. The inventor is Mr. H. Johansson, of Stockholm, who discovered the method when searching for a means of soldering aluminium. It is stated that, by the new process, not only is the surface of iron objects covered with aluminium, but the aluminium actually penetrates into the metal, and at a certain temperature a thick coating of an alloy of aluminium and iron covers the metal. At a higher temperature the coating does not possess such a satisfactory power of resistance. The invention, in its present stage, can, it is claimed, be used for many purposes for which an iron surface is to be protected from oxidisation, fire, acids, &c., but experiments are being continued in order to increase the elasticity and flexibility of the plated iron. A factory for the exploitation of the invention on a limited scale is now being equipped at Stockholm by a company called Aktiebolaget Stockholms Aluminiumiseringsfabrik.

Miscellanea.

ACCORDING to a statement in the Russian paper, *Za Industrialisatzu*, the use of electro welding machinery in Russian metallurgical circles is becoming increasingly important, and as the Russian electrical industry is unable to cope with the demand for this machinery it will be necessary to import it from abroad or to discontinue electrical welding.

AS several incorrect references to the date of the forthcoming inquiry have appeared in the Press, the Electricity Commissioners announce that the public inquiry into the application of the Metropolitan Borough Council of Fulham for consent to extend its generating station in Townmead-road, Fulham, will be held on the date originally fixed, viz., Monday, December 15th, at the Institution of Electrical Engineers, Savoy-place, Victoria Embankment, W.C. 2, beginning at 10.30 a.m.

AN electric power ship, the "Jacona," has, says a message from New York, been put into service at Bucksport, Me., by the New England Public Services. The ship originally belonged to the Shipping Board, but it has now been equipped to provide a "stand-by" electric service for the interconnecting electrical systems of northern New England. It is pointed out that such a floating plant costs a good deal less than the stationary steam plants that would otherwise be required, and it is believed that about twice as many hours of use will be possible, as with a stationary plant, and that the length of transmission lines to assure stand-by power and constant service to all parts of a regional power system is also reduced by the use of a marine power unit.

To solve the problem of electrification of goods yards and termini, the New York Central Railway has recently ordered a large number of battery-oil-electric locomotives. Faced with the practical impossibility of completely electrifying the yards, and with the object of eliminating the noise and smoke associated with steam locomotives, an intensive study of the operating conditions was carried out. It was found that, for starting and accelerating trains, a locomotive capable of developing 1000 H.P. was required, although the average power required throughout the full working period varied between 30 to 100 H.P. With the object of combining the storage battery's capacity for providing heavy currents for high tractive efforts with the low cost of developing power by means of a Diesel engine, and, further, to obtain full flexibility of operation on electrified sections of the line, a combination battery-oil-electric locomotive was developed and exhaustive trials carried out.

IT is reported from Bogotá that the Colombian Congress has authorised the Minister of Public Works to conclude a contract for the completion of the Bocas de Ceniza project. A concession will be granted to a firm, native or foreign, agreeing to finance and construct the project. Preliminary negotiations have been begun, and it is hoped that operations will recommence early next year. The works are intended to permit ocean-going vessels to enter the Magdalena River at Barranquilla, 7 miles from the river mouth. The port, which handles 60 per cent. of the entire trade of the country, is already served by the Barranquilla Railway and Pier Company, a British undertaking. Operations will start with the dredging of the sand bar at the mouth of the river. The western extension will have a total length of 5120 m., of which 2155 m. remain to be completed; the eastern extension will be 2360 m. long, of which 2135 m. have yet to be built, and the estimated cost of the undertaking is 3,000,000 dollars gold, in addition to 5,400,000 dollars already spent.

ADDITIONAL expenditures approved of by the Canadian Government brings the total outlay for the Dominion Provincial and Municipal Governments for unemployment relief, and relief works up to 45,660,705 dollars. The amount is distributed as follows:—Nova Scotia, 1,025,305 dollars; Prince Edward Island, 144,000 dollars; New Brunswick, 406,300 dollars; Quebec, 3,501,800 dollars; Ontario, 10,735,103 dollars; Manitoba, 593,740 dollars; Saskatchewan, 1,476,941 dollars; Alberta, 2,667,536 dollars; British Columbia, 3,325,482 dollars; Yukon, 5000 dollars; Canadian Pacific Railway, 11,514,000 dollars; Canadian National Railway, 11,765,498 dollars; level crossing fund, 500,000 dollars. The Canadian National programme as finally arranged includes a subway at Oshawa, Ont. (225,000 dollars), two subways at Toronto (1,000,000 dollars), Brantford cut-off of 6 miles (1,350,000 dollars), subway and track elevation London (1,207,010 dollars), railway bridge, Sudbury (179,589 dollars), freight storage shed at Fort William (132,000 dollars), division railway line at Westport (550,000 dollars), relaying 160 miles of main line with heavier rails (1,103,054 dollars), and laying 143 miles of new branch lines (1,540,000 dollars). While most of the expenditure involved in this work is provided for by the Dominion Government, a portion of the cost will be borne by the railways.

A 760-MILE pipe line from the Texas Panhandle to St. Louis, embracing many innovations in oil transport, is now under construction for the Phillips Pipe Line Company, a subsidiary of the Phillips Petroleum Company, to expedite movement of the company's petrol from the Texas oilfields to important retail marketing centres. Fifteen booster stations, placed at intervals along the line will receive the oil at about 50 lb. pressure and deliver it back into the line at between 750 lb. and 800 lb. pressure. The conventional motor-driven direct-connected circulating pumps at the booster stations will be displaced by gas engines driving very high-speed pumps, through speed-up gears. Gas from the company's fields, of which there is an abundant supply, will be "slugged" in liquid form into the pipe line and pumped between consignments of commercial petrol. These slugs of fuel will be withdrawn at the booster stations and stored in tanks, awaiting use by the pumping engines. Each booster station is to be equipped with three pumping units, two of which will provide for the line's designed capacity of 30,000 barrels a day, one being used only as an emergency standby. The engineers engaged in the construction of the line hope for a greater transport capacity at less cost per barrel for the long run when the line is completed. The pipe line products, on arrival at the St. Louis terminus, will be shipped east, north and south, *viâ* the Mississippi River.

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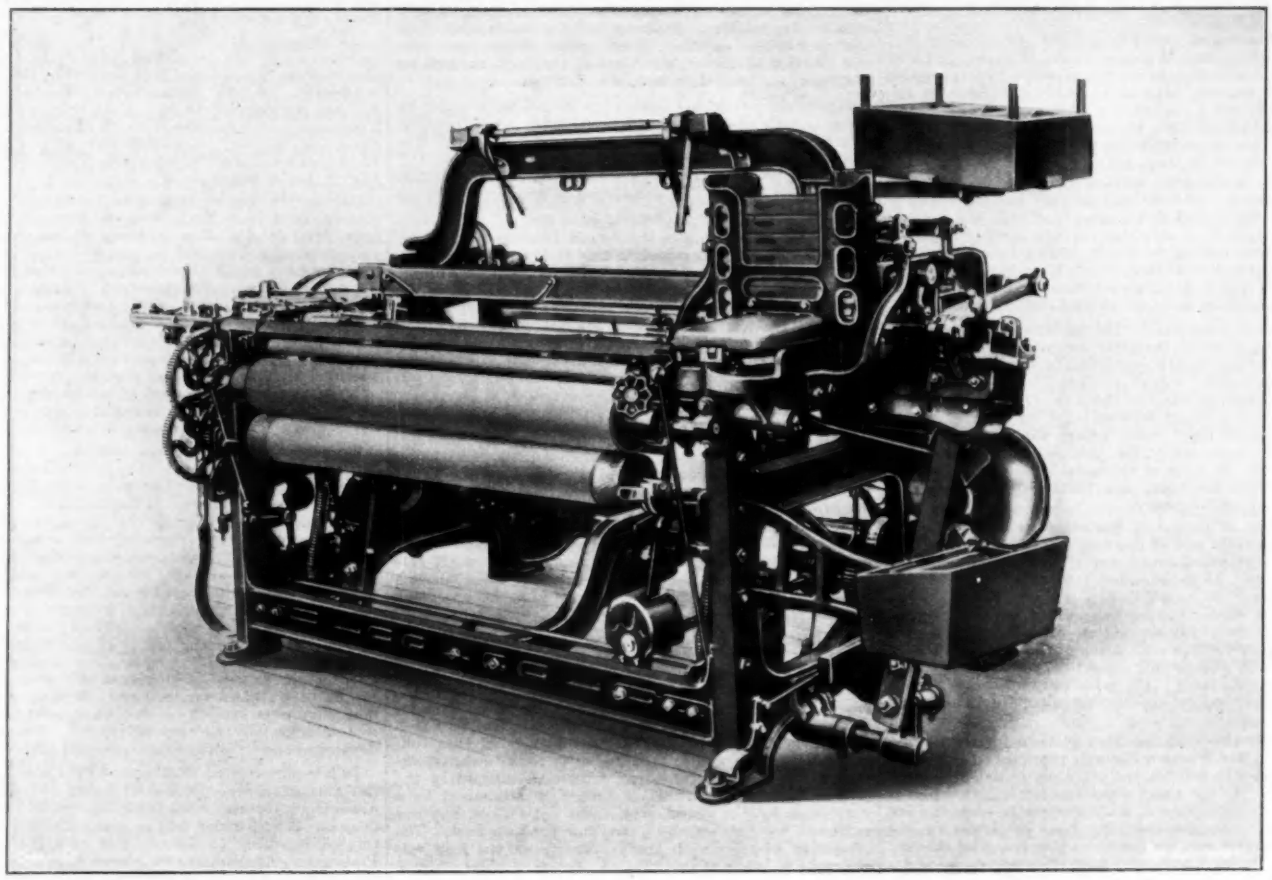

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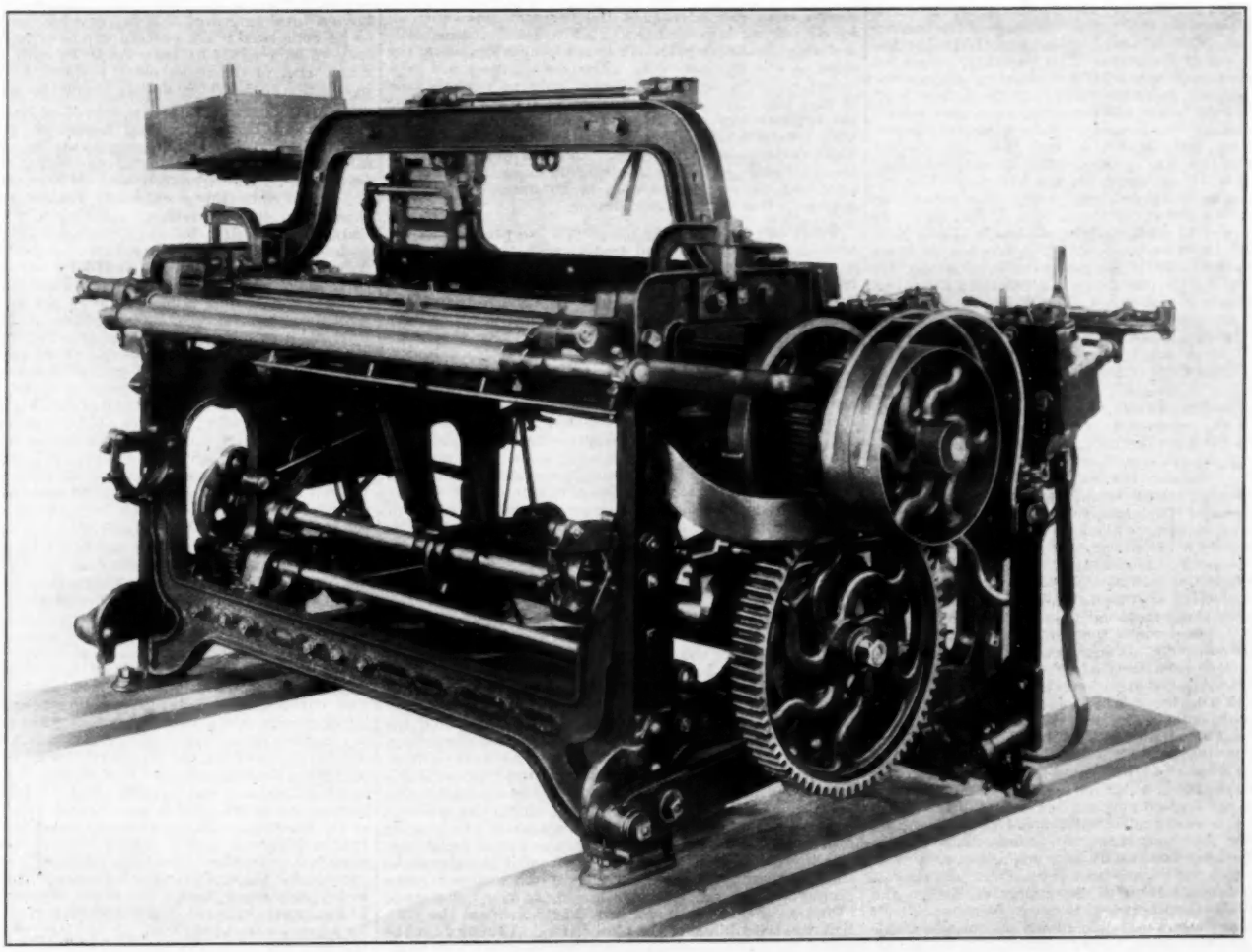

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† $15·25	New York, N.Y., December 12th, 1896, under the Act of March 3rd, 1879 (Section 397, P.L. & R.)

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THE ENGINEER.

VOL. CL No. 3909

DECEMBER 12, 1930.

Waste in Industry.

THE Council of the Institution of Chemical Engineers deserves thanks and some commendation for its choice of Industrial Wastes as the subject for its two days' Conference in London on December 4th and 5th. The close connection between waste elimination and industrial efficiency has been somewhat neglected in this country, for although during the later stages of the war much attention was given to the study of wastes, that was due chiefly to the shortage of many of the raw materials required for manufactures, and to the necessity for obtaining substitutes or supplies from other sources. A very large number of processes for the recovery of materials from so-called waste products were patented during the war years, and were brought into use between 1916 and 1918. After the Armistice was signed, however, the majority of these new recovery processes were allowed to fall into disuse, and during the past ten years the British manufacturer has given less attention than his competitors in Germany and America to waste treatment and recovery. German technologists have always devoted much attention to the subject, but in America the position was very similar to our own, and until the end of the war American manufacturers gave little heed to processes of waste recovery. In 1920, however, Mr. Hoover, who then filled the position of Secretary of State for Internal Affairs, arranged for an intensive examination of the wastes occurring in some half-dozen typical American industries, and the results of that investigation were published in 1921, in a book entitled "Waste in Industry." The serious wastes revealed by this inquiry caused manufacturers all over the States to investigate more closely the wastes in their own works and factories, and led ultimately to a great improvement in the efficiency with which their manufacturing operations were conducted.

It is self-evident that the reorganisation which is now being carried out in nearly every branch of British manufacturing industry ought to cover the elimination of wastes. But "rationalisation," to make use of that much-overworked word, is being carried out chiefly by financiers, amongst whom there is a tendency to regard amalgamation as the most important part of the work, and to be satisfied when the leading firms in any particular industry have been formed into one or two groups. The second step, namely, that of closing down the smaller and less efficient units of each group, and of concentrating the production or manufacture in one or more of the larger and better equipped works and factories, is now in progress, and when that stage has been completed there is a danger that those in control of these changes may be disposed to take a rest and to consider that all has been done which is possible to render the particular industry well equipped to meet world competition. This attitude is a mistaken one, and the Institution of Chemical Engineers Conference was a timely reminder that amalgamation is only one of the steps required for obtaining higher efficiencies from our manufacturing industries and that the elimination of all wastes, whether of time, labour, or material, is required before the rationalisation of any industry can be considered complete. The most noteworthy example of rationalisation in this proper sense of that term is provided by the alkali industry, in which rationalisation occurred before the German word came into use in this or any other country, thus proving once again that many ideas and inventions, for which other nations get the credit, originate here. Alkali, for over a century, had been produced by what was known as the Le Blanc process of manufacture, and that process was worked with considerable success in South Lancashire, and on the Tyne and Clyde, down to the end of the nineteenth century. The industry began to lose ground, however, when a new method of alkali manufacture, known as the Solvay process, was introduced into this country in the 'seventies by Brunner, Mond and Co., and the decay of the older process was accelerated when another new method of decomposing common salt came into general use in many of the countries which had formed our best markets for the sale of caustic soda and bleaching powder. This new process was the electrolytic method of alkali manufacture, and it provides a striking example of the elimination of waste in a very old established industry, for in it a comparatively simple electrical process of decomposing common salt was substituted for the half-dozen processes by which the older Le Blanc process effected the same decomposition, and the various wastes which occurred at each stage of the Le Blanc process were thus avoided. Had the men in control of the heavy chemical industry in this country at that stage of its history simply sat down and done nothing to meet the intensified competition to which it was then exposed, both in the home and foreign markets, its collapse would have been certain. They met the situation with courage, however, and not only consolidated the industry by forming a combine and closing down the superfluous and less efficient works, but followed that step up at a later date by scrapping the whole of the plant used for the older process and by adopting the newer electrolytic method at the chief centres of the industry, without any assistance from the banks or from the Government of the day. The later history of the industry in this country is well known to all readers of this paper, for it is now merged in that of the Imperial Chemical Industries, Ltd., which controls the four separate groups of heavy chemicals, dyes, explosives, and base metals, and forms one of the most progressive and powerful industrial combines in this or any other country.

The elimination of waste in an industry, however, does not always call for such drastic methods as the scrapping of old-established processes and the whole of the plant that has been in operation for years, but can, generally, be attained by the further treatment of the waste materials, produced in the course of manufacture. In some cases these wastes are of an objectionable character, and require treatment before they can be discharged, without causing a nuisance, into the air or into rivers or streams; while in other cases they may be innocuous and unobjectionable in themselves, but contain valuable ingredients which can be recovered by suitable methods. The most notable example of the treatment of a waste of the objectionable type, that was, nevertheless, regarded as an unavoidable adjunct of the alkali manufacture in its early days, was that of the gases from the furnaces in which common salt was treated with sulphuric acid, for the production of sulphate of soda. Before the passing of the Alkali Act of 1863, this hydrochloric acid gas was allowed to escape into the air, but after its condensation had been made compulsory, it provided the raw material for one of the most successful and profit-earning branches of the heavy chemical industry. The

use of blast-furnace slag for the manufacture of tarmac, cement, and vinculum concrete is another notable example of the successful application of a waste product, the disposal of which had spoiled the natural scenery in the iron-smelting districts of the Midlands and North. The enormous mounds of this waste slag are now being gradually removed, as a result of the inability of the small number of blast-furnaces at present in operation to meet the growing demands for slag made by these newly established industries. With such examples as these before them, our manufacturers cannot fail to find encouragement for such efforts as they may make to reduce wastes or to convert them to useful purposes. Indeed, the elimination of waste on all hands, whether it be of material, labour, or money, must be one of the primary concerns of all who seek for the organisation of industries on more economical and efficient principles.

City Noise.

YEARS ago, when this was, possibly, the first technical newspaper to protest against the excessive noises of London streets, its views were received sympathetically only by a handful of people, who were regarded by their fellows as super-sensitive, and were rejected by engineers as advocating a course which would interfere with the development of industries and the expansion of trade. Just as they had rebelled against the regulations prohibiting the emission of black smoke, so they resented any effort to reduce the noise produced by mechanical devices. They had not reached that higher level of thought which requires that engineers should give humanity all that it demands, free from obnoxious or injurious concomitants. They had not yet begun to measure efficiency by a larger scale and to admit that other things besides those that can be estimated on a slide rule must be included in it. From what they gave with one hand they took something back with the other. They provided, to take but a single example, cheap electricity, but they blackened the atmosphere so that more of the light they provided was needed. But since those days a slight change in their attitude has taken place. They do at length admit, grudgingly perhaps, that the highest level of mechanical engineering will only be reached when it ceases to retain any of its obnoxious features. That is an advance in grace, and we hope to see the day when every engineer will blush with shame if the products of his hands are noisy or filth producing, or poisonous or vibratory, or offensive in any way.

The problem of city noises is already being attacked in several countries. Here we have approached it in a half-hearted spirit, and made a few regulations, which are only in part effective. In Germany a little more pains have been taken, and more stringent regulations have, at least, been formulated. In France an educational campaign against the unnecessary blowing of motor horns—which has taken the place of the famous whip so beloved by Sappho's disreputable old father and cracked to distraction by ten thousand *cochers*—has been opened. In America a systematic research has recently been completed and a report has just been published by a special commission. It is a thick volume with copious illustrations, and is clearly intended to be "popular." The methods of the commission present only one aspect of techpical interest, the use of a special vehicle fitted with apparatus for the measurement of sound, which visited many parts of the City of New York. But the report includes a striking array of testimony given by a large number of physicians, neurologists, professors of otology, and medical research workers, upon the ill effects which noise has upon the human system. Where it lacks is that too often it attacks the noise itself instead of the cause. For example, the racket that is made in the construction of steel buildings or the excavations of foundations is condemned, but the principal recommendation is that the emission of it should be limited to certain hours of the day, and be prohibited as far as possible in certain areas—in the neighbourhood of schools and hospitals. Yet it does recognise that something more is needed, for after quoting the following notice, posted upon a building under construction in Broadway, "Our sincere apologies to our neighbours for the unavoidable annoyance this hammering must occasion," it remarks that "these thoughtful gestures speak highly for the kindliness and good manners of modern builders, but by their futility they afford a strong argument for the necessity of finding some way to do away with the major noises of construction and demolition." We trust that the signs of grace that glimmer through those words will be pursued. In this instance the technologist's voice can be heard, but in the majority of cases it is the policeman who speaks, and no attempt is made to go beyond noises directly traceable to human agency, such as the unnecessary hooting of motor horns and the dreadful blare of competing loud speakers in "Radio Row," though it is hardly necessary to say that the clatter of street cars and lorries and overhead railways is too insistent to escape attention. Taken for all in all, the report is a valuable and effective document which cannot fail to serve a useful purpose. It is wanting only in a clear statement that it is the engineer who is responsible for a very large proportion of the greater noises, that he could obviate or reduce noises, and that it should be his duty and his pride to do so.

In its conclusions the commission writes: "We recommend a comprehensive and energetic educational campaign to arouse public consciousness to the evils of noise and advantages of a quieter city," and it advises that a permanent noise squad should be authorised by the city government as part of the Health Department. Both recommendations are sound. Science has now provided the means by which noise can be estimated with reasonable accuracy, and the promulgation of records of offences can hardly fail to have some effect as soon as the public has become as familiar with decibels as it is with therms. But we count the arousing of public consciousness of even greater importance, for it will be by that means that the reduction of noise is effected rather than by any regulations. Indeed, it is doubtful that any regulations would be effective at all had they not got public opinion behind them. Speaking as engineers, we should rejoice to see the evils of noise so prick the consciousness of all who belong to our profession that they would not tolerate it in any of their undertakings, but would apply their technological knowledge and science persistently to its elimination. If the engineer will provide, as he can do, machinery which is free from noisiness, then it will be possible to enforce regulations for the prohibition of the neglect or misuse of such machinery.

Literature.

Mine Atmospheres. By Dr. WILLIAM PAYMAN and Professor I. C. F. STATHAM. London: Methuen and Co., Ltd. 1930. Price 10s. 6d. net.

THIS small work is the fourth of the series of Methuen's Monographs on Coal Mining, edited by Professor Henry Briggs, of Edinburgh. Like the previous volumes of this series, it is of a conveniently small size, and deals with a small but important section of the entire subject of coal mining. Many readers may be repelled by the opening sentence, in which the authors have thought it necessary to give the Greek derivation of the word atmosphere, but further examination of the book will show that this excess of pedantry is by no means characteristic of the rest of the work, which is written in simple style and should prove of considerable assistance to all engaged in coal mining. As pointed out in the Preface, contributed by Sir Henry Walker, H.M. Chief Inspector of Mines, the information contained in this book is for the most part to be found elsewhere, but it is scattered through such a number of official reports and technical papers that few men engaged in the daily work of coal mining would have either the leisure or the material at hand for gathering together the information for themselves, and they are therefore under a debt of gratitude to the authors for having done this work for them. The volume is essentially divided into two parts. The first, consisting of eight chapters, deals with the nature of air and of the gases met with in the mine, their physiological effects, and the nature of gas and dust explosions; whilst the second part, which is addressed more particularly to chemists engaged in such work, consists of four chapters dealing with sampling, detection, and estimation of mine gases and mine dusts. The authors have had considerable experience in dealing with the subjects which they discuss, and the work on the whole may be looked upon as quite reliable. It is only when they go beyond their proper sphere that they are liable to go astray. For example, two entirely different definitions of metabolism are given, and it need hardly be said that one of them is necessarily wrong. A still more striking mistake is that to be found on pages 122 and 123, where the authors state that "the drying of air in blast-furnace practice is frequently accomplished by passing the feed air over trays of calcium chloride." As far as we are aware, there is really no foundation whatever for that statement.

In dealing with the subject proper of the book, the authors have, however, collected a vast amount of information, and have presented it in a convenient and accurate form, and the book can undoubtedly be considered as a valuable and useful addition to the series of which it forms part.

Business Charts. By T. G. ROSE, M.I. Mech. E. London: Sir Isaac Pitman and Sons, Ltd. 1930. Price 10s. 6d. net.

To advocate before engineers the extended use of charts and graphical representations of the problems with which they are confronted, would unquestionably savour of preaching to the converted. The author has primarily in mind that wider business community which does not normally include squared paper amongst the tools of its trade, and to such this little treatise will prove useful and suggestive. At the same time the engineer will not regret reading a book in which will be found much which he can heartily endorse.

The circle, or pie chart, so frequently encountered in popular journals, is deprecated as misleading, and a glance at the figures showing a comparison between a circle of double the diameter and another double the area of a common one, readily substantiate the contention of the author.

The section devoted to bar charts is interesting; in perusing it the impression is formed that probably engineers are too wedded to the line diagram, which has no appeal to the uninitiated, whereas a judiciously coloured bar chart could be exploited advantageously to interest the untrained worker, such as a storekeeper, in the results of his activities.

Perhaps the most valuable among the many described is the Z chart, so called because the three curves on it form the letter Z. The current monthly results, the cumulative monthly results, and the moving annual total are plotted, and obviously for absolutely stable conditions a uniform Z would appear. Fluctuations from this are apparent at a glance, and useful information is readily gleaned. That the actual figures on which all charts are based should be displayed as an integral part of the diagram is strongly urged by the author. If engineering students were to study this little work carefully before commencing to make graphs, fewer indifferent charts would be noticed, even in engineering works.

Electricity on Gasworks. By H. C. WIDLAKE. London: Walter King, Ltd. Price 21s.

GAS engineers who are contemplating introducing electric driving into their works will find this book distinctly useful. Although much has been written on the application of electricity to various industries, hitherto there has been a decided deficiency of information bearing on this particular application. As the author points out, the question has been raised as to whether it is a wise policy for an undertaking in active competition with an electricity supply authority to use electric power itself for its works purposes, and there are to-day gas undertakings in which the cost of the finished product is kept unduly high by an unfortunate deference to this prejudiced and wholly illogical view. If the book has the effect of causing gas engineers to view electricity from a different standpoint, so far as their own works are concerned, it will have served a very useful purpose. Gas engineers have no reason to be ashamed of making use of electricity, and those who have not as yet considered the matter might study this book with advantage. The case for electric driving in gasworks is set forth in clear and unmistakeable terms, and much light is thrown on the subject generally.

To the source of power supply the author devotes considerable attention, and the conclusion is reached that, with modern methods of steam production and a good load facto, relectricity can generally be produced on the works site at a cheaper rate than it can be produced in bulk. It is also contended that it is highly undesirable that the continuity of so vital a public service as gas supply should be dependent in any degree whatever upon an extraneous source of energy over which the gas undertaking has no control. Such matters as the selection of the site for generating sets, the selection of a generator, the switchboard and distribution are very fully considered, and the all-important matter of the cost of driving by steam, gas and electricity is also dealt with. Other sections of the book cover direct-current motors, motor control gear, the position of motors, converting existing plant, miscellaneous applications, metering gas by electricity, control instruments and load estimates. The author has clearly devoted considerable attention to the subject of electrifying gasworks, and his book should prove of considerable assistance to those who are desirous of undertaking work of that nature.

BOOKS RECEIVED.

The South American Handbook, 1931. London: Trade and Travel Publications, Ltd., 14, Leadenhall-street, E.C. 3. Price 2s. 6d. net.

Engineering Insurance. By H. R. Sketch, A.C.G.I., &c. London: Post Magazine and Insurance Monitor, Ltd., 9, St. Andrew-street, E.C. 4. Price 5s. 6d. net.

Index to the Literature of Food Investigation. Volume 2, September, 1930. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 1. Price 2s. net.

Mercury Arc Rectifier Equipment for the Melbourne Tramways.

ALTHOUGH only eight years have elapsed since the first public supply sub-station equipped with glass bulb mercury arc rectifiers was put into operation, the total capacity of this class of plant in this country is now over 150,000 kilowatts. In 1925 we published a description of a 2000-kilowatt sub-station on the City of London company's system, which at the time was the largest sub-station of its kind in the world; whilst last year we dealt with the Evelyn-street sub-station, Shoreditch, which has a capacity of 5700 kilowatts. Coupled with this development there has been progress in exports, and the Hewittic Electric Company, Ltd., of Hersham, Walton-on-Thames, which makes these glass bulb rectifiers, has supplied equipments to the Dominions, India, South America, &c. As early as 1922, *i.e.*, about the time that rectifiers were beginning to gain a footing in sub-stations in this country, 230-kilowatt and 300-kilowatt equipments were sent to Karachi and the Montevideo waterworks respectively, and were installed and put into operation by the resident engineers, who, up to then, had never seen plant of this description. That the plant has proved satisfactory appears evident from the fact that three additional equipments have been sent to Karachi and another to the Montevideo tramways, whilst others have been supplied to Lucknow, Allahabad, Bombay, Delhi, and Quetta in India; Timaru, New Zealand; and Cairo. A number of installations have also been put into operation in Australia at Sydney, Adelaide, and Melbourne.

The largest equipment sent to Australia for the Melbourne tramways has a capacity of 500 kilowatts, and is designed to operate on a 6600-volt, three-phase system and to feed into a 600-volt D.C. two-wire system, the plant being arranged for fully automatic control. From the diagram of connections, Fig. 1, and from Fig. 2 it will be seen that the plant comprises an E.H.T. oil switch controlling the 6600-volt incoming supply, a transformer, the bank of rectifiers, a high-speed circuit breaker controlling the D.C. output, and an automatic control panel.

The rectifier equipment proper is made up of the four rectifier bulbs, their auxiliary gear and the main transformer. Each of the four bulbs is rated at 125 kilowatts, giving 500 kilowatts in all, and they are assembled in sheet steel cubicles, each bulb unit being provided with independent isolating and protective gear and with its own independent auxiliary circuits. The main circuits for each bulb include an isolating triple-pole switch, fuses in the anode circuits, and a set of equalising coils to divide the three-phase supply into each bulb evenly between the six arms of the bulb. Each bulb is also provided with a ventilating fan and a starting and maintaining—or exciter circuit—fed from a small auxiliary air-cooled transformer mounted at the base of the cubicle. The starting of the rectifier bulb is effected by means of a flexible electrode, controlled by an electro-magnet placed next to it, with the result that the old system of tilting the bulbs is eliminated. On the primary side the transformer is delta-connected and has a twelve-phase zig-zag secondary, and an auxiliary winding is provided to feed the various auxiliary circuits of the rectifiers. No-load tapping switches control tappings, giving plus and minus 1¼, 2½, 3¾ and 5 per cent. of the normal voltage.

The sub-station is brought into operation by means of a voltage relay and/or a time switch, and is shut down by means of a low-current relay or a time switch. Push buttons are also provided on the control panel as an alternative means of control, and by means of a similar set of push buttons operating over pilot wires, the sub-station can be controlled on the remote system. An auxiliary transformer fed from the E.H.T. incoming supply feeds the starting circuits which are, therefore, independent of the D.C. network. The E.H.T. switch is motor-operated.

The pressure and current relays for switching on and off are operated *vid* thermal relays which prevent operation of the switches on the occurrence of load fluctuations of a transient nature, the relays being adjustable between the limits of 1 and 5 minutes. Two contactor breakers control the output from each pair of bulbs to the positive bus-bar, whilst the high-speed breaker shown in the diagram of connections connects the negative pole of the rectifier equipment—*i.e.*, the neutral point of the transformer secondary—to the negative bus-bar. On opening, the high-speed circuit breaker inserts a buffer resistance between the negative pole of the rectifier and

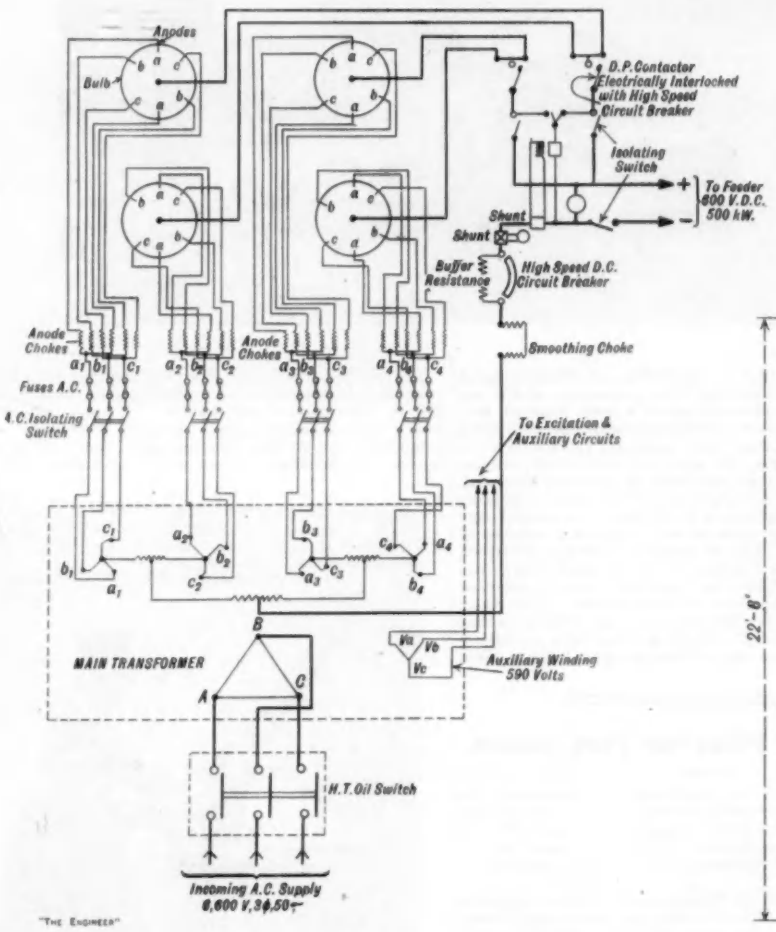


FIG. 1—DIAGRAM OF CONNECTIONS

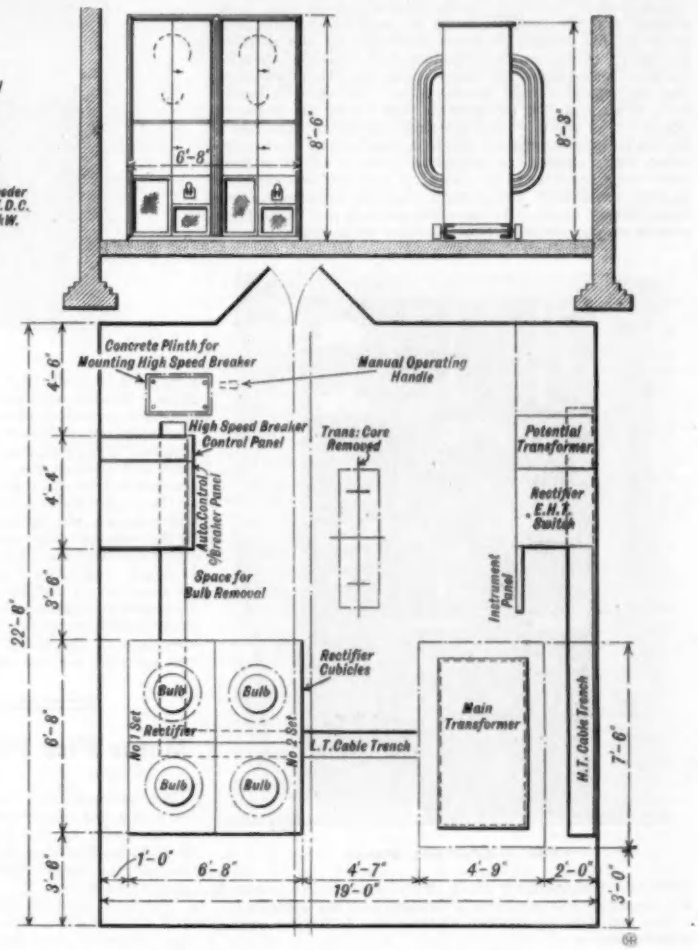


FIG. 2—ARRANGEMENT OF RECTIFIER PLANT

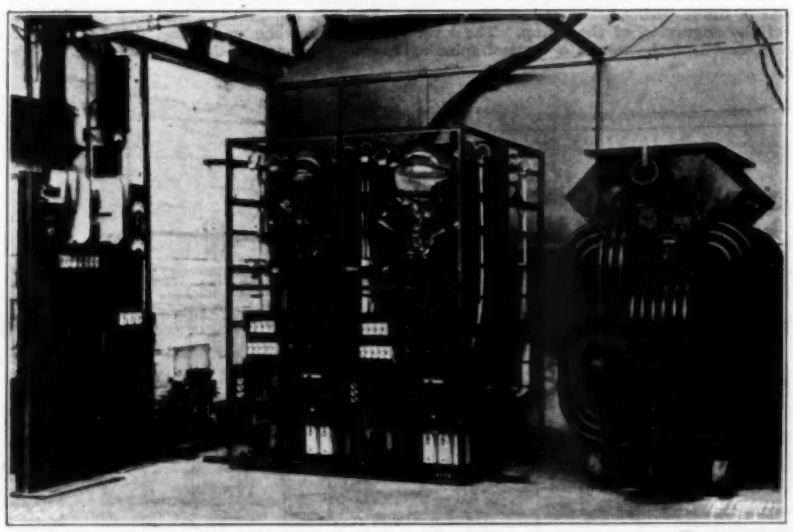


FIG. 3—RECTIFIER PLANT ON TEST

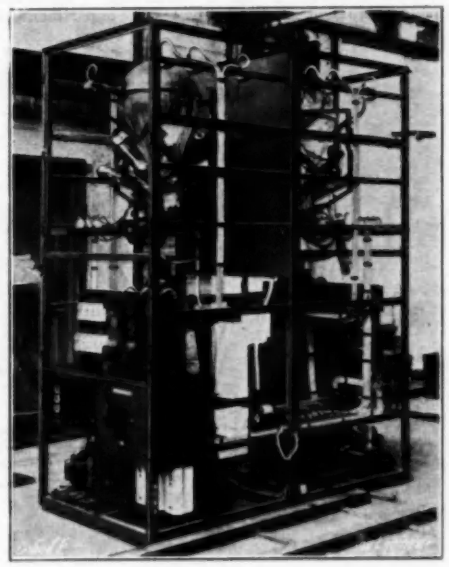


FIG. 4—RECTIFIER CUBICLE

the D.C. network, and so limits the output to 1000 ampères at 600 volts, until the main contactor opens. The main contactors which control the supply from the rectifiers to the positive bus-bar, are set so that they always close just before the high-speed circuit breaker, and open after it, so that they never have to deal with more than 1000 ampères.

The sequence of operation during starting is as follows :—(1) The load demand from the network causes a pressure relay to operate ; (2) this sets a time delay device operating, and after the lapse of time for which this device is adjusted the operating contactors close ; (3) the motor-operated E.H.T. switch closes, thus energising the transformer, and the rectifier bulbs at once strike their arcs, when a D.C. supply is made available on the rectifier bus-bars ; (4) the main contactors then close and energise the positive feeders ; (5) immediately after this operation, the high-speed circuit breaker short circuits the buffer resistance, and the equipment then feeds the network direct. The whole of the starting operations take but a few seconds to complete, and in a similar way the equipment shuts down, the sequence being :—(1) The low-load relay operates ; (2) the time lag device operates ; and (3) the E.H.T. switch trips, and the D.C. contactors immediately follow. If the equipment is put on to time switch or push-button control, then with the exception

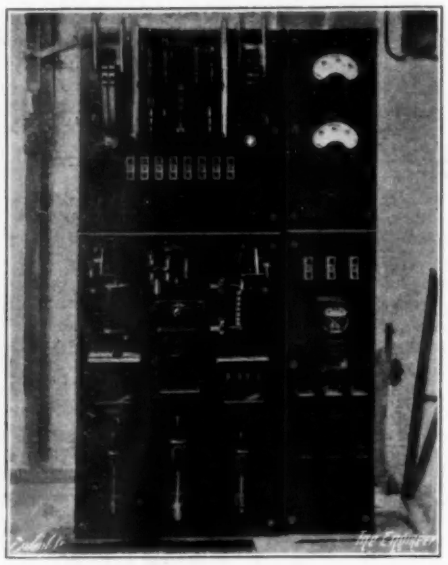


FIG. 5—CONTROL PANEL

that the intermediary time delay devices are omitted, the sequence of operations is the same as that described.

On test the equipment showed the following overall efficiencies :—

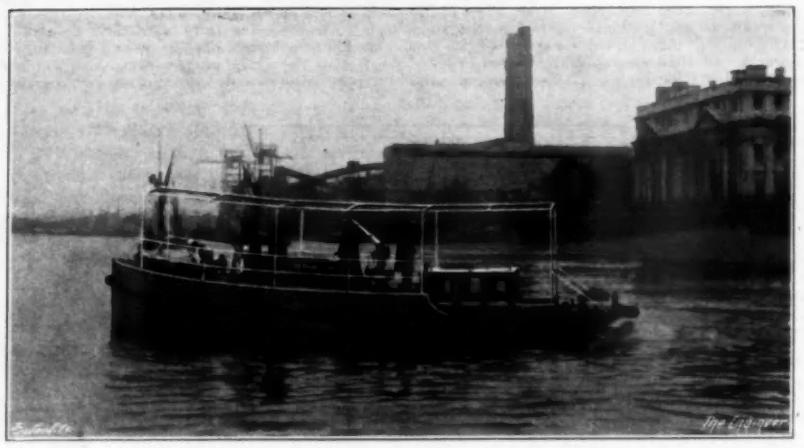
5/4 load	93·15 per cent.
4/4 ,, ...	93·75 ,,
3/4 ,, ...	93·75 ,,
2/4 ,, ...	93·35 ,,
1/4 ,, ...	91·15 ,,
No load losses	7·4 kW
Regulation	4 per cent.

The figures cover the complete plant from the E.H.T. supply to the D.C. bus-bars and take in all the switchgear, the transformer, rectifier, and all control gear. The plant is designed to withstand 25 per cent. overload for two hours, and peak loads of short duration of 200 per cent. The overload test at the maker's works was carried out at 50 per cent. overload, and the plant was also subjected to short circuits on the D.C. side. The lay-out of the sub-station is shown in Fig. 2, whilst Fig. 3 shows the complete equipment erected in the testing department of the maker's works. Fig. 4 gives a side view of two of the cubicles, and Fig. 5 a view of the automatic control and instrument panel.

The rectifier bulbs are protected against abnormal trouble by means of fuses in the anode circuits, but they are very heavily rated, and, in the ordinary way, they do not come into operation, overload and fault conditions in the network being taken care of by the automatic breakers.

MOTOR FIRE FLOAT FOR PORT SUDAN HARBOUR

MERRYWEATHER AND SONS, LTD., GREENWICH, ENGINEERS



Excessive load on the D.C. side brings out the high-speed circuit breaker and positive D.C. contactors, which are arranged to reclose after a lapse of a short interval, say, 5 seconds, and if in that interval the conditions have been restored to normal, they will remain in. If, however, the fault still remains, they will again trip and reclose, and the process will be repeated from three to six times, according to the adjustment of the notching device, and if the fault still persists, the breaker will ultimately be locked out. If the breaker only trips on any occasion a number of times less than the lock-out number of notches, for which it is set, and then remains closed for more than, say, 12 seconds, all the notches taken will then be returned back to the initial position, and the breaker will be ready with its full complement of notches for any other fault that may arise. The E.H.T. switch is fitted with an under-voltage relay, no load trip coil, and an earth leakage relay.

Motor Fire Float for Port Sudan.

WE recently had an opportunity of witnessing the trials of a new motor fire float which has been constructed to the order of the Sudan Government, for service in Port Sudan Harbour, by Merryweather and Sons, Ltd., of Greenwich. We give herewith a drawing and some engravings of this vessel.

The hull, entirely of British steel, is 43ft. in length, with a moulded breadth of 9ft. and moulded depth 4ft. 6in., the maximum draught being 3ft. The deck runs over the machinery space forward, with hatchways to the machinery space and the fore cabin, and a large skylight over the engine. Aft of the machinery space there is a small cabin with seats, a folding table, &c., the cabin sides being fitted with glazed windows. Double doors are arranged at the after end for access from the cockpit, and there is also a fore cabin with seats and a table.

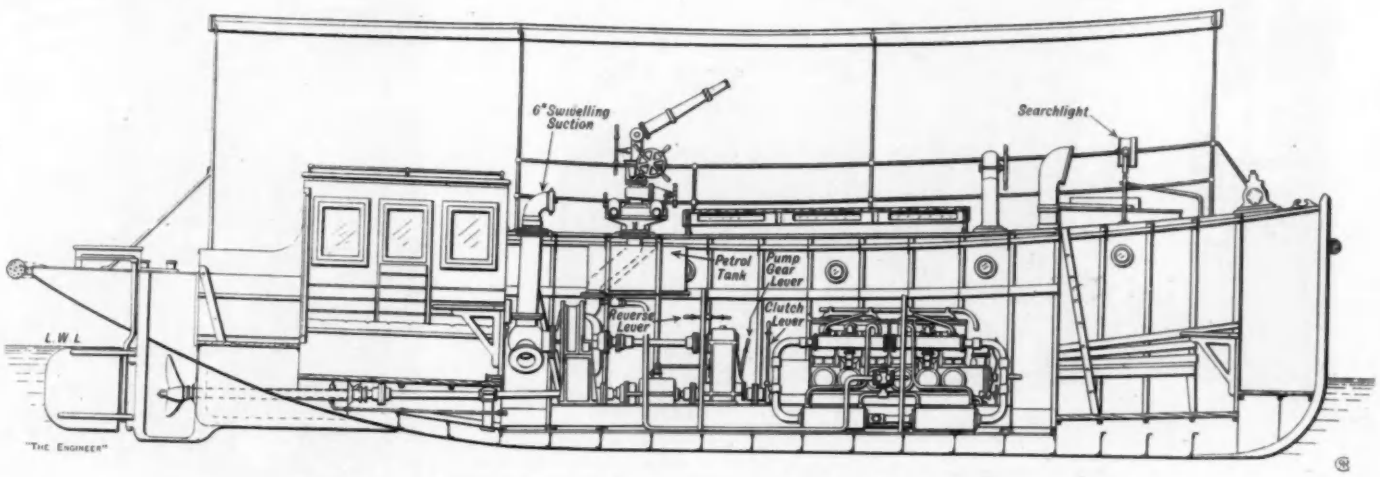
The petrol motor engine for propelling the vessel and driving the fire pump has six cylinders, 6½in. bore by 8in. stroke, and is capable of developing 110 H.P. at 900 revolutions per minute. Electric starting gear is fitted, with alternative hand starting. The engine drives the propeller, which is 30in. in diameter, through a clutch and reversing gear, which are plainly shown in the drawing, while the cover of the reversing gear can just be seen at the bottom of the engraving of the pump. The lever for reversing is shown at the top of a vertical spindle. The gear, which is of the positive type, has a neutral position, so that the pump can be driven apart from the propeller. The pump is driven through a silent chain gear in the standard just aft of the engine. This gear, in turn, drives an overhead lay shaft connected with the pump spindle by flexible couplings. The lever for this gear is in the foreground of the picture of the pump and can, it will be seen, be held in engagement by a link and chain.

The fire pump is of the Merryweather high-lift, multi-stage centrifugal type, and is designed to deliver from 800 to 1100 gallons per minute. It has a gun-metal casing and impeller. The complete machinery unit, comprising the engine, reversing gear, pump drive and pump, is assembled on two stiff longitudinal girders,

THE MONITOR

bolted to the engine-room floor, to ensure the proper alignment of the several parts.

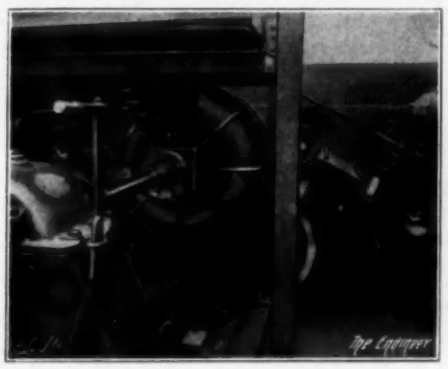
There is a pump suction inlet on either side of the vessel, below the water line, fitted with a strainer box having a removable door and strainer. There is also a suction branch on deck, fitted with a swivelling bend for taking 6in. hose, so that the vessel may be used for salvage purposes. The pump delivery is taken up on deck and feeds a rectangular box—see the picture of the monitor—which is equipped with four hose connections fitted with rack valves. The monitor has a 4in. connection and is, it will be seen, controlled by two worms and hand wheels. It is intended to throw a 2in. jet.



LONGITUDINAL SECTION THROUGH THE FIRE FLOAT

A dynamo electric lighting and starting equipment is provided, the electric starter fitted to the engine being operated by means of a special switch. A searchlight on a swivelling bracket is fitted on deck right forward. The equipment of the vessel includes an engine-room telegraph, navigation lamps, side fenders, suction and delivery hoses, and a canvas awning extending about three-quarters the length of the vessel. Storage is provided for sufficient petrol for 6 to 8 hours' service with the maximum load.

During the speed tests on the Thames, the vessel attained an average speed of 10 miles per hour over the measured mile, and other tests comprising turning circles, and running full speed astern for several minutes, were satisfactorily carried out. The pumping trials took



FIRE FLOAT PUMP

place at Westminster Pier, when a high-pressure jet was thrown to a height of about 180ft. from a monitor with a 1¾in. nozzle, at a pressure of 115 lb. per square inch. On being directed horizontally, the jet reached half-way across the river. Subsequently, six 1in. jets were delivered at a pressure of 80 lb., four 1in. jets at 100 lb. pressure, and one 1in. jet at a pressure of 180 lb. per square inch.

The Manufacture of Sheet Glass.*

By PROFESSOR W. E. S. TURNER, D.Sc., Sheffield.

Sheet Glass from Blown Cylinders.—Until the present century the two processes employed for the manufacture of sheet glass both consisted initially in the blowing of a cylinder. In the manufacture of the so-called "crown" glass the end of the cylinder away from the glass-maker's blow-pipe was then cut open, the cylinder reheated until quite soft, when, by spinning it round at a rapid rate, the cylinder was caused by centrifugal force to open ever more widely, until, finally, a circular plate was obtained, with the lump remaining in the centre by which the cylinder was attached to the blow-pipe. This process has gone out of general use, although still employed for making roundels for ornamental purposes.

The second method consisted in opening one end of the cylinder, as in the first method, detaching the cylinder from the blow-pipe, and cutting off the other end so as to produce a perfect cylinder, splitting this cylinder lengthwise, and then, after re-softening the split cylinder in a subsidiary furnace, flattening it out into a sheet.

This last method was the one in common employment in Europe and America throughout the nineteenth century and, until after the war, was the main means of production in Europe. For example, in Belgium alone in 1913, 442 million square feet, out of the total of 460 million square feet made in that country, were produced by this cylinder method. The size of cylinder made in this process differed in different countries. In Belgium, England and America it was usually 5ft. 6in. to 6ft. in length and 10in. to 12in. in diameter.

The Machine Cylinder Process.—The first successful attempt to increase the production of window glass by machinery was an elaboration of the hand method. Like the two other later processes in use at the present day for the manufacture of window glass, this cylinder process involved a long period of patient experiment before it became commercially successful. The inventor of the process was J. H. Lubbers, a window-glass flattener in the employ of James A. Chambers, glass manufacturers in Pittsburgh. He believed that it should be possible to draw cylinders of glass from a receptacle into which the requisite amount of glass had been placed. His experiments began in 1894, but were not commercially successful until 1903. The American Window Glass Company took up this process and has continued to employ it until quite recently.

In the most recent practice employed by the American Window Glass Company, and those who have worked the machine under licence, the glass is melted in a large tank furnace. One such furnace had a length of 140ft., a width of 39ft., and a depth of molten glass of 5ft., equivalent to a capacity of 2000 (short) tons. From this furnace molten glass is ladled out into a shallow saucer-like pot, of which Fig. 1 is a diagram, which has a diameter of about 42in. This fire-clay pot is double, so that by reversing it the half which has already served as a container for glass for the drawing of a cylinder can be allowed to drain while the other part, now cleaned, is brought into use. Such a pot is mounted in a convenient way for reversal and gas jets are applied to bring the charge of glass already in the pot to the correct temperature for the drawing process. The charge inserted in it depends on the size and thickness of the cylinder to be drawn and may vary, therefore, from about 550 lb. to 1000 lb. The temperature of the glass is adjusted to about 2200 deg. Fah. before the drawing operation begins.

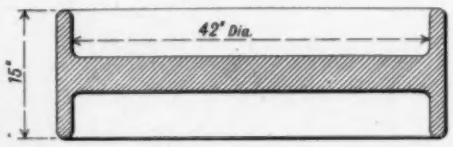


FIG. 1. FIRECLAY POT.

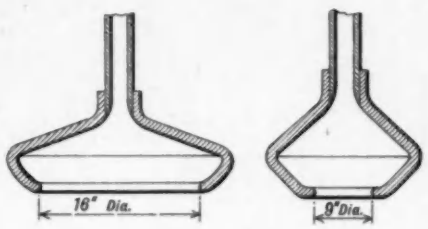


FIG. 2. "BAIT" OR "BLOWING HEAD."

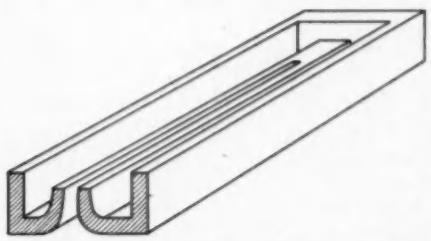


FIG. 3. DEBITEUSE FOR FOURCAULT VERTICAL DRAWING PROCESS FOR SHEET GLASS.

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The drawing of the cylinder is carried out by means of what is known alternatively as a "bait," or a "blowing head," types of which are shown in Fig. 2. The blowing head is of iron and in shape suggests a mushroom. It is lowered at the end of a great length of flexible steel tube, which supplies the necessary air for distending the walls of the cylinder, and is sunk into the pot until the glass wells up within its lip. In some cases this lip may be electrically heated to accelerate the adhesion of the glass to the iron. One of the principal features of the Frink cylinder process was the use of an electrically-heated bait. When the glass has adhered to the bait the latter is very slowly withdrawn from the pot and a glass cap immediately begins to be formed. The diameter of the cylinder is greater than that of the blowing head, and that diameter can be maintained by adjustment of the wind pressure applied through the tube attached to the blowing head.

The wind pressure is applied by an operator working the controls in a cabin perched high above the drawing pots. He usually controls a number, for example, three, such drawing pots. At first the wind pressure applied is quite small, as, at the outset of the drawing, the glass is still hot and soft. With the lapse of time, however, the glass gets colder; not only the temperature of the cylinder walls falls, but the temperature of the charge of glass in the pot also. In consequence, the speed of drawing is gradually increased, as also is the wind pressure. Cylinders have been drawn up to 518in. in length and of a diameter up to 40in. The time of drawing depends on the thickness of the cylinder wall and the total length, and may vary between 15 and 18 minutes.

At the end of the drawing operation the cylinder is raised very quickly, the result of which is to make the walls of the cylinder become very thin so that the cylinder can easily be broken away from the glass remaining in the pot.

The cylinder is then lowered on to a carrier, known as a "horse," is trimmed from the cap and the thin end, then cut into shorter cylinders by means of an electrically-heated wire made to encircle the cylinder, and these shorter cylinders are then opened out in just the same way as the small hand-made cylinders; that is to say, they are split longitudinally, sometimes, indeed, into two segments, which are heated up on a smooth stone surface in a flattening oven, and when sufficiently soft, the final flattening is done by an operator using a flat block of wood at the end of a pole, thus smoothing out the glass in much the same manner as ironing a fabric in a laundry.

This process was in widespread use in America until very recently, and has been operated in France, in England and in Japan. At the factory of the American Window Glass Company the hand operators in competition with the machine gradually raised their output per man per week to 6000 square feet. One cylinder machine, however, made ten times this quantity in the same time, and, moreover, the size of the sheets obtainable was very considerably greater.

Processes for Drawing Sheet Glass Direct.—The sheets of glass formed by flattening a cylinder, whether hand-made or machine-drawn, have the disadvantage of never being perfectly flat, and the waviness of the surface produces a distortion of vision which, in some specimens of window glass, is most pronounced, whilst it is never entirely absent. Hence, it is not surprising that hopes had long been entertained prior to the processes recently brought to success, of being able to draw sheet direct. William Clark, in St. Helens in 1857, made the earliest recorded attempts, but he never overcame the difficulty of preventing the width of the sheet from contracting as it was withdrawn. This difficulty was surmounted, however in the present century in the processes devised by Emil Fourcault, in Belgium, and by Irving W. Colburn in the United States. The two inventors were carrying on their experiments practically simultaneously. Fourcault took out his first patents in 1904 and at length, in 1913, a machine produced a substantial quantity of drawn sheet glass at the parent factory at Dampremy, near Charleroi. Not until after the war, however, was it possible to exploit the process to the full. The idea of Colburn, which eventually proved to be the basis of the Libbey-Owens process, occurred to him in 1905, after a visit to see a paper-making machine. From that year to 1912 more than 1,000,000 dollars had been expended by the Colburn Machine Glass Company, when it became bankrupt. The Toledo Glass Company bought the patents and set Colburn at work again. Success came in 1916 after the expenditure of a further 1,000,000 dollars on experimental work, and the Libbey-Owens Sheet Glass Company was formed to exploit the process.

The Fourcault Process.—In the Fourcault process the sheet is drawn vertically upwards from a chamber containing molten glass. For that purpose a portion of the molten glass is isolated by drawing it through a slot in a fire-clay device known as a "debiteuse." Figs. 3 and 4 show such a debiteuse in plan and in various sections. Its surface, especially the curved under-surface against which the flow of the glass will occur, is made thoroughly smooth. The slot in the debiteuse has a width which is greatest at the centre and tapers somewhat to the ends. If placed in molten glass, the debiteuse will float and when depressed uniformly, the glass is forced through the slot and, if drawn away, a continuous flow will be produced through the slot, so long as the debiteuse remains depressed

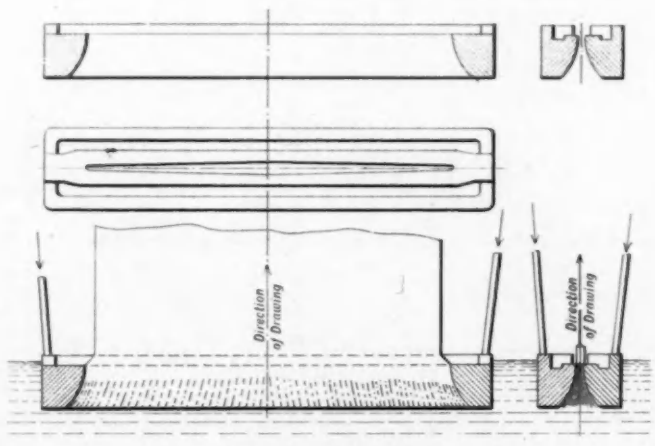

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FIG. 4. DEBITEUSE IN SECTION.

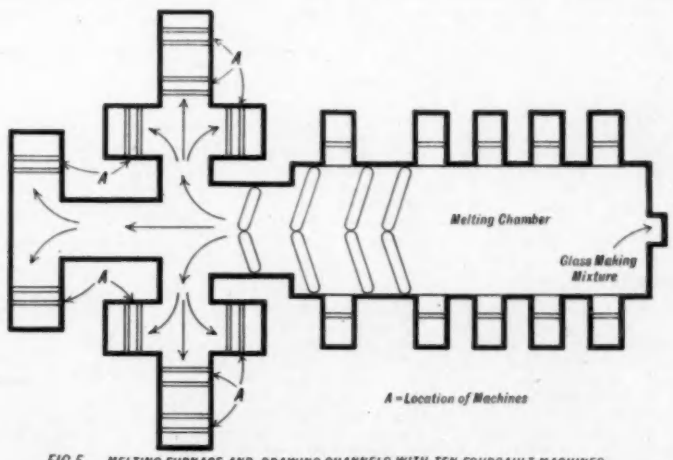
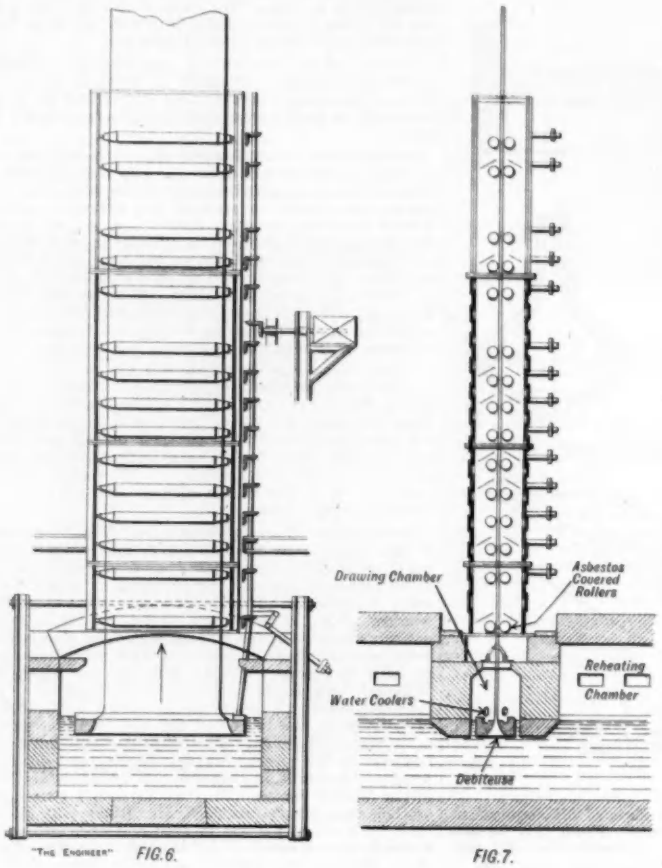


FIG. 5. MELTING FURNACE AND DRAWING CHANNELS WITH TEN FOURCAULT MACHINES.

* The Institution of Mechanical Engineers—Abstract.

below the general level of the glass. This stream of glass forms the basis of the sheet which is drawn from the slot vertically upwards by a series of asbestos-covered rollers to grip and propel it upwards through a chamber in which it slowly cools off.

Fig. 5 illustrates in plan a glass-melting tank furnace, supplying molten glass to ten Fourcault sheet-glass drawing machines. The furnace proper is divided into zones in which melting, refining, and cooling of the glass occurs, these zones being separated by floating fire-clay bridges. Then follows a neck through which the glass passes and is distributed to the channels across which the drawing machines, A, are placed at right angles. The dimensions



"THE ENGINEER" FIG. 6. FIG. 7.

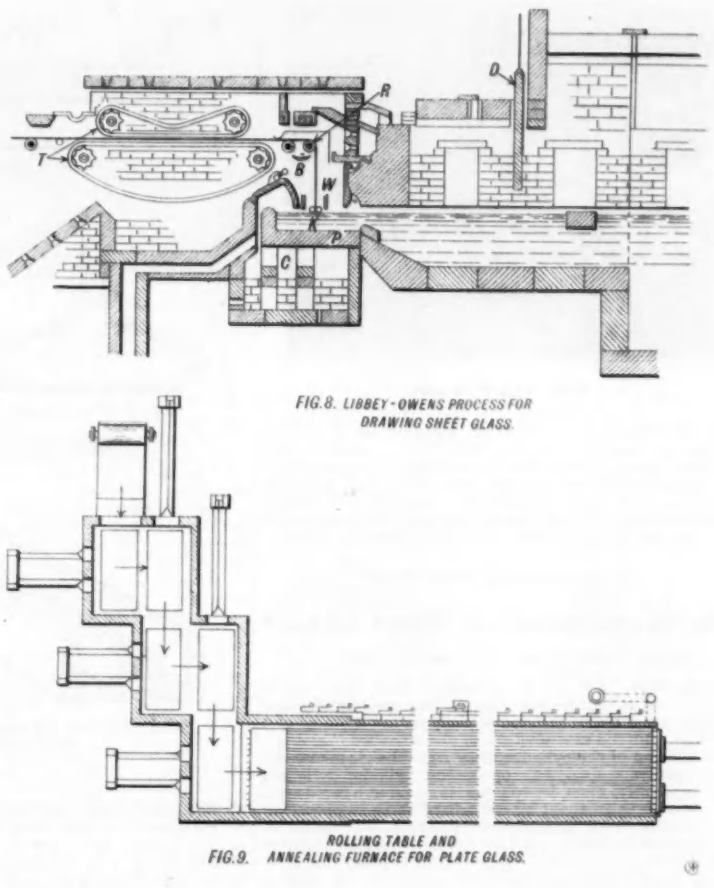


FIG. 8. LIBBEY-OWENS PROCESS FOR DRAWING SHEET GLASS.

FIG. 9. ROLLING TABLE AND ANNEALING FURNACE FOR PLATE GLASS.

and capacity of the furnace and drawing chambers vary with the number of machines to be operated; the total capacity of some furnaces exceeds 1500 tons. Each drawing chamber is isolated by refractory walls, which dip about 8in. below the glass in the channel, and below these walls molten glass from the furnace can continue to flow in a steady stream. Each portion of the main channel between the walls of two adjacent drawing chambers constitutes a heating chamber, in which burners operate in order to maintain the glass at the required temperature for drawing in the adjacent chamber. For heating the glass in the reheating and drawing chambers clean gas is employed, either purified producer gas, or, in the United States of America, natural gas.

Figs. 6 and 7 show respectively a longitudinal and a cross-sectional drawing illustrating the process. The debiteuse having been placed in position at right angles across the direction of flow of glass into the chamber, a wire mesh panel framed by sheet iron is let down through the drawing chamber with the lower edge in alignment with the slot of the debiteuse. The bottom end of the iron frame carries a row of protruding clean iron nails, which hang vertically below it, and ensure good contact between metal and glass. That contact having been secured, the frame or "bait," as it is called, is drawn slowly vertically upwards.

Immediately above the slot and on both sides of the debiteuse are long flat metal boxes, through which a constant stream of cold water passes to chill the glass and render permanent the sheet. The latter presently reaches and is gripped by the asbestos-covered rollers, which have a diameter of about 6in., tapered at their ends to leave the edges of the sheet free, and are mounted in pairs. The rollers on the left-hand side are fixed. The right-hand rollers are adjustable, each by a weighted arm, so that they ride on the surface of the sheet and adjust themselves to any change of thickness.

The chamber in which these rollers operate is of cast iron. At its lower end it opens into the drawing chamber, at its top end into the cutting-off chamber, where an operator cuts lengths of standard size from the continuous band. Within the chamber is a lining of asbestos to insulate it. One side is provided with hinged doors which can be opened for inspection, and thermo-couple pyrometers are placed at intervals along the chamber length to assist in controlling the rate of cooling.

Strict temperature control is an essential factor in the successful operation of the Fourcault process. Insulation of the walls of the canals and drawing chambers is now being adopted. The temperature of the glass in the drawing chamber is maintained at about 1040 deg. Cent. The precise value depends on the glass composition, but whatever it is, it must be kept constant if the thickness of the sheet is to be maintained constant. A thermo-couple in a protecting sheath immersed in a fixed position in the glass, is employed to give a continuous record. The temperature of the sheet is reduced to about 600 deg. Cent. by the coolers in the region just above the debiteuse slot. The sheet must be rigid before it reaches the first pair of rollers, a state attained by the glass commonly employed at a temperature in the neighbourhood of 540 deg. Cent. The first pair of rollers is maintained at a temperature of about 500 deg. Cent., the last of the twelve pairs enclosed in the cooling chamber at 125 deg. Cent. There are usually six further pairs of rollers, propelling the glass into the open room, to cool it sufficiently rapidly for the cutters to handle Shattering of the sheet does not occur readily below about 450 deg., so that in case of breakage higher up in the chamber, the lower rollers still exercise grip on the sheet below and maintain continuity of action.

The rate of drawing the sheet depends on the thickness. Single strength glass—thickness 2·2 mm., or twelve sheets to 1in. thickness, weight 18½ oz. to the square foot—which is the commonest variety, is drawn at the rate of about 140ft. per hour, which means that any point in the cross section passes through the annealing or cooling chamber in about 7 minutes. Despite the short time of passage, the glass is fairly free from strain. The standard machine draws a sheet of about 75in. wide, but the standard width tends to rise, as it is obviously more economical, within limits, to produce wide sheets. Machines recently—1929—installed by the American Window Glass Company draw a sheet 84in. wide, but others have been for some time in operation producing a sheet 90in. or more in width.

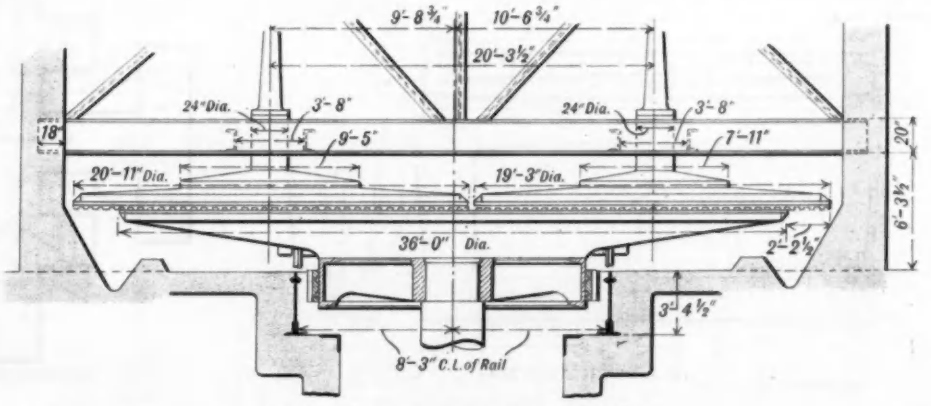
The number of machines working at each furnace varies. The smallest number is four, and the largest number tried, so far as the author is aware, is fourteen.

The Libbey-Owens Process.—The Colburn, or Libbey-Owens process differs from the Fourcault in several essential features. The flat sheet is drawn from the free surface of the molten glass. Its width is maintained, not by a drawing slot or debiteuse, but by knurled rollers operating at the edge of the sheet. The initial direction of the drawing is vertical, but changes in a short distance to the horizontal; and, lastly, the annealing chamber is 200ft. long, as compared with about 16ft. in the Fourcault method.

The general procedure is illustrated in Fig. 8, which shows the channel supplying molten glass from the furnace to the drawing pot P. The latter is a fire-clay trough or saucer in which a constant depth of about 6in. of molten glass is maintained. The temperature is kept constant by the heating chamber C, below the trough, which is supported by silica pillars and by burners operating above the glass at the sides of the trough. A damper D provides protection from gaseous currents from the main furnace.

In order to start the machine operating a "bait," consisting of a flat iron bar about 6ft. long and 6in. wide, is lowered into the glass by reversing the machine, flexible metal strips attached to the bait being used to permit of the bait being passed over the bending roller R. As soon as the glass has adhered to the bait, the latter is drawn upwards and over the bending roller and for a further distance of about 10ft., when it is cracked off and the sheet propelled forward by the tractors T.

The knurled rollers K are water cooled, and are placed between 1in. and 2in. above the surface of the molten glass. They are rotated at a peripheral speed somewhat less than that at which the sheet itself moves forward, and they engage the sheet for about 2in. on each side, forming a thicker edge strip, marked by the rollers, which must be cut off from the sheet when cold. In order to give immediate stability to the sheet, water-cooled screens W are stretched across the trough; but as this chilling causes a partial setting, it is necessary to reheat the sheet by a burner B before it passes over the roller to assume the horizontal direction. To bring about this change of direction without unduly marking the sheet, a close study of temperature adjustment and roller construction and operation was necessary. The roller is of metal, with a wall 1in. in diameter. This roller, and the idler roller near by, are so cooled with air that the temperature is high enough to prevent the glass sheet from being checked, yet not high enough to cause the glass to stick to them.



"THE ENGINEER" FIG. 10. 36 FOOT TABLE FOR GRINDING PLATE GLASS

After passing the tractors T the sheet enters a horizontal annealing chamber, 200ft. long, the conveyor of which consists of 200 asbestos-covered rollers. Gas burners through the sides of the lehr are spaced at intervals required to control the rate of cooling, and a series of thermo-couples along the lehr length assists in the control of the temperature.

The drawing speed of the machine varies from 25in. to 100in. per minute for the limits of thickness $^{5}/_{16}$in. to $^{1}/_{24}$in. Sheet $^{7}/_{16}$in. has been drawn. The capacity of each machine for window glass of single strength is 2500 to 2750 square feet per twenty-four hours. The machines operate day and night, seven days per week. As against the multiple arrangement of machines in the Fourcault process, the maximum number of Libbey-Owens machines per furnace is two.

The Manufacture of Plate Glass.—The form of sheet glass commonly described as "plate" is produced by rolling out a mass of glass either by one or by a pair of rollers. The process originated in France in 1688, the invention of Lucas de Nehou, and until recently had undergone little change in principle. On the other hand, the certainty of control, the speed of operation and size of sheet produced have made great advances during this century and in particular the speed of grinding and polishing.

In the earlier years of its production polished plate glass was consumed mainly in the manufacture of mirrors and in Germany is still known as Spiegelglas. In modern times, its widespread use for building construction, and especially in motor cars, has led to greatly increased demands. Nowhere has this been so marked as in the United States of America.

In view of this activity, it is not surprising that serious attempts have been made to evolve continuous processes. In most mass production methods of glass manufacture tank furnaces have replaced pot furnaces for melting the glass. This is true of bottle glass, electric light bulbs, certain types of domestic glass and window glass, and tank furnaces supply the glass for making cast and rolled glass of certain types, namely, rough rolled, corrugated and wired glass. But whereas bubbles and other imperfections are of less account in the last-named types, polished plate glass shows them up very readily. Polished plate glass must, in consequence, be regarded as a "quality" glass and at present can be most successfully melted in small units, that is, in pots. There are in use at present three processes. The first, which we may describe

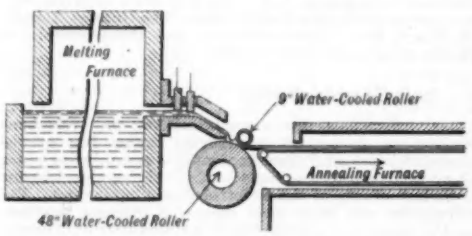


FIG. 11. FORD CONTINUOUS PROCESS OF ROLLING PLATE GLASS.

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as present standard practice, directly developed from the original; the second, the continuous process, of which the best known form is that developed and used at the River Rouge Works of the Ford Motor Company, U.S.A., and the Bicheroux process, of quite recent introduction. Each will be briefly described.

Present Standard Practice.—The mixture is melted in open fire-clay pots, usually slightly oval in cross section, with a flange by which the pot can be lifted by means of a crane, and in the most modern works the mixture is charged into the pots automatically from a hopper-mounted truck which runs on rails parallel to the length of the furnace. The melting furnace is rectangular, with regenerative preheating of air and gas, has either four or five arches on each side, in each of which two pots may be placed, thus constituting a sixteen or twenty-pot furnace, and the flames pass down its length between and above the pots. An average pot will hold 2000 lb. of glass and yield a plate of about 300 square feet; but larger sheets are at times rolled. After the melting and refining of the glass is complete the pot is removed by a travelling crane to the casting table, and the glass teemed on to it across its width immediately in front of the roller, the temperature of the glass having already been reduced to about 1000 deg. Cent.

The casting table for a sheet of 300 square feet is about 14ft. by 24ft., is built up of layers of cast steel to give a total thickness of about 8in., and means are provided of cooling the table as uniformly as possible. Fig. 9 represents diagrammatically the arrangement of the roller and table in relationship to the annealing furnace at the beginning of casting. The roller of steel is about 30in. in diameter and is of grooved or hammered surface, to prevent sticking to the glass. Prior to each casting the table is spread uniformly with a layer of sand to prevent the glass sticking to the table, and after the casting and rolling the table is swept.

Rolling the glass into a sheet takes about one minute, and if $\frac{1}{4}$in. polished plate is required the rolled sheet is about $\frac{1}{4}$in. thick—more precisely $^{15}/_{32}$in. Immediately after being rolled the plate is transferred to the annealing furnace, but as it is for some time altogether too soft to be lifted it is pushed not only into the first, but also into four subsequent compartments of the furnace arranged zigzag until it has become set. From this stage it passes into the straight part of the lehr, extending for a length of 400ft. to 500ft., in which the plate rests on rods or rails, between which transporter rails can be raised to lift the plate and move it forward at a regulated rate.

From the end of the annealing furnace the glass emerges into the cutting room, where after inspection it is cut into suitably sized pieces, which have to be ground and polished. It has already been mentioned that $\frac{1}{4}$in. polished plate begins as cast plate $^{15}/_{32}$in. thick and the wastage not only amounts to nearly 50 per cent., but time and power are consumed, apparently needlessly, in grinding. The chief trouble lies in the relatively small unevenness, through warping, of the casting table, but this lack of flatness has made it impossible, by the standard process, to make the cast plate less than about $\frac{1}{4}$in. thick.

The grinding and polishing tables, circular in shape, are mounted on platforms and run on rails; the diameter of the tables may be 24ft., 28ft. or 36ft., the last named weighing 75 to 80 tons. The sheets of glass are embedded in plaster of Paris and after the upper side has been ground and polished the table must be stripped and the glass reversed and re-set.

Fig. 10 is a diagram of a grinding table, which consists of two circular discs, each of about half the diameter of the table, operating over the latter, which also rotates. Blocks of cast iron are bolted to the lower rim of the grinding disc and must be carefully levelled, so as to lie flat on the glass.

The actual grinding is done by sand or other abrasive, which is fed with water automatically to the tables, about 10 lb. of sand being used per square foot of polished surface. Coarse sand is fed to the tables during the earlier stage of grinding and is followed by increasingly fine grades and by fine emery or garnet. Considerable saving of time in this operation has been made by automatic arrangements which collect the sand or other abrasive from the table, reclassify the particle sizes and return the required sizes in a constant succession.

The polishing operation is carried out on a similar table, but with felt blocks instead of iron blocks and with a regulated supply of rouge and water.

Pneumatic lifting devices with suction pads are employed for picking up and conveying the large sheets of plate glass.

The Ford Continuous Process.—The principle involved in the Henry Ford process is illustrated in Fig. 11. A tank furnace discharges glass at a controlled rate from an outlet into the space between two rollers and the strip of glass resulting glides on to a continuous belt conveyor, which carries it through the annealing furnace.

At the River Rouge plant four complete units operate in parallel, each consisting of a regeneratively-fired tank furnace, rolling mechanism, annealing furnace, and continuously operating grinding and polishing plant. Each furnace has a width of 20ft., the melting end being 40ft. long, the refining end 16ft., but there is a taper at this end leading to the discharge channel. With a depth of 5ft. the furnace has a deadweight capacity of about 400 tons and delivers about 32 tons (metric) each twenty-four hours. Coke oven gas, produced on a neighbouring site at the River Rouge plant, is used as fuel. The width of the discharge spout is 14in., the rate of discharge is controlled by fire-clay gates, and a series of gas jets playing on the glass as it emerges from the spout on to the rollers maintains the temperature at the requisite degree for rolling. Of the two cast iron rollers, the upper is 9in. in diameter, the lower 48in.; each is cooled by a continuous stream of water, thermostatically controlled to maintain a temperature of 82 deg. Cent., and the lower roller has a peripheral speed of about 40in. per minute. The width of the sheet resulting is 40in., the standard width of the motor car screen. On leaving the rollers the sheet settles on to a travelling belt, designed to maintain a flat surface, and immediately enters an annealing furnace of the muffle type, 440ft. in length, the earlier sections being heated by gas provided with automatic temperature regulation. In the first section of this annealing furnace the temperature is maintained at 592 deg. Cent. and is reduced in each of the nine succeeding sections by 28 deg. down to 343 deg. Cent., and finally emerges at little more than room temperature. The cooling process occupies about 2 hours 20 minutes, and in view of the cooling and contraction of the sheet the speed of emergence is about 2 per cent. slower than that of entry into the annealing furnace. The capacity of each of the rolling units is about 16,000 square feet per day.

The sheet emerging from the annealing furnace is slightly dappled and must be ground and polished. As the thickness is approximately $^{3}/_{16}$in., the reduction needed to produce $\frac{1}{4}$in. plate is comparately small. Lengths of 9ft. are cut from the continuous sheet and transported to the polishing floor. Grinding and polishing are carried out by continuous processes, the required tables forming two long lines parallel to the annealing furnace. Each long line of grinding and polishing tables is formed of unit rectangular tables, 9ft. 7in. by 3ft. 7in., clamped together, each mounted on wheels so that the line of cars can move progressively forward on rails. The tables are topped by plates which are machined level, and on to them the glass sheets are set in plaster of Paris. They then move slowly forward below a set of forty-three grinders and thirty-six polishing wheels. The grinders are themselves divided into two sub-groups. The first, of twenty-nine, constitutes what may be described as the coarse polishing section, and is fed with sand and water. Here, again, by a grading of the sand supplied at different stages, the sand grinding itself gradually assumes a finer grinding. Between the twenty-nine sand grinders and those fed with garnet is a washing section, and after the fourteen garnet grinders have been passed, a further washing section intervenes before the polishers, fed with rouge and water, come into action. When the glass emerges from below the last polisher, it is stripped from the table, turned over and re-set, the individual cars are transferred by a turntable to the second grinding and polishing line and the process repeated on the second face of the glass. Each grinding and polishing line is of approximately the same length as the lehr. The fully polished sheet is then washed in hydrochloric acid, dried, and inspected.

The Bicherouz Process.—It will have been clear from the description of the Ford process that whereas it has been found impossible by means of a single roller and a flat table to produce a plate thinner than $^{15}/_{32}$in., the use of two rollers, as in the Ford process, makes it possible to produce a plate very closely approaching the final thickness which the ground and polished plate will possess.

This use of two rollers is, however, not novel to the Ford process. Initially, indeed, in the development of this same process, a single roller and a moving table—that is, the flat belt conveying the sheet into the annealing furnace—were employed. The use of a double roller was a design of Chance in a machine for rolling plates, dating back to 1890. Moreover, plates of various types, including figured plate and wired glass, have been made in rolling machines employing a double roller.

The Bicheroux process, on which the inventor was already engaged before the war, employs in its successful form two rollers of the same diameter. Prior to the war Bicheroux had found it possible to roll thinner plate than is possible by the standard casting process, by rolling the glass between two rollers, allowing the plate to pass forward on to a moving car, cutting the plate while still soft, and transferring the individual plates in this way, by means of the travelling car, direct into the annealing furnace.

The new invention has resulted in considerable stimulus to the pot-melting process, as against the continuous process illustrated by that of Ford. It embodies several new ideas. In the first place, in the older standard process the pot is tipped upside down over the rolling table, with the result that the glass descends a considerable distance. In the Bicheroux process, instead of the axis of movement corresponding to the axis through the centre of gravity of the pot of glass, it runs parallel with the lip of one of the long sides of an oval-shaped pot. This is accomplished—see Figs. 12 and 13—by pouring the glass from the pot on to a plate which can be raised gradually in an inclined position, so as to discharge the glass down between the rollers. There is in consequence no vertical fall of the glass, but only a flow on to the iron plate and down the plate as that is gradually raised. This method of carrying out the teeming operation is much less likely to entrap bubbles of air than in the old process, and there is less risk of impurities being incorporated in the glass, due to matter falling from the sides of the pot when inverted.

The glass so poured passes in a stream through the rollers and emerges from them on to an inclined plane and a bed on to which powerful cutting knives descend at intervals, severing the soft glass into discontinuous sheets, which are then conveyed to the annealing furnace.

By this process a pot which contains 850 litres of molten glass will produce as much as 60 square metres of rolled plate, whereas by the old method, employing a fixed casting table, the same quantity of glass produced a plate of only 31·5 square metres. The plate by the Bicheroux process is rolled to a thickness only slightly greater than that it will have ultimately when ground and polished.

In the later developments of this process plates as long as 100ft. have been rolled. They are conveyed straight to the annealing furnace down an incline of rollers, and a system of rollers forms the conveyor through the length of the annealing furnace itself. The transport in the annealing furnace is not continuous, but the rollers can be reversed so that the plate first progresses forward and then moves back a shorter distance, this to-and-fro movement being arranged to assist in maintaining a greater degree of uniformity of temperature in the region of the lehr occupied by such substantial lengths. The annealing furnace for operations of such magnitude must be much greater than under the standard fixed casting table arrangement, in which case a length of 400ft. to 500ft. was entirely adequate. The newest process involves the use of an annealing furnace more than 700ft. long. Naturally the substantially reduced thickness makes it possible for the cooling to take place more quickly than under the old system. With cast sheets about $^{15}/_{32}$in. thick, the time occupied in passage down the lehr was about 3 hours. In the Ford process any point on the continuous sheet emerges from the 440ft. annealing furnace after about 2¼ hours. In the newer process the plates pass through in about 1¼ hours, despite the greatly increased length of annealing furnace.

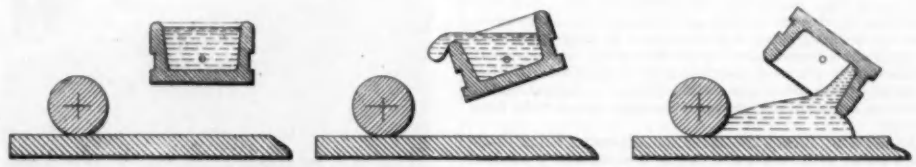
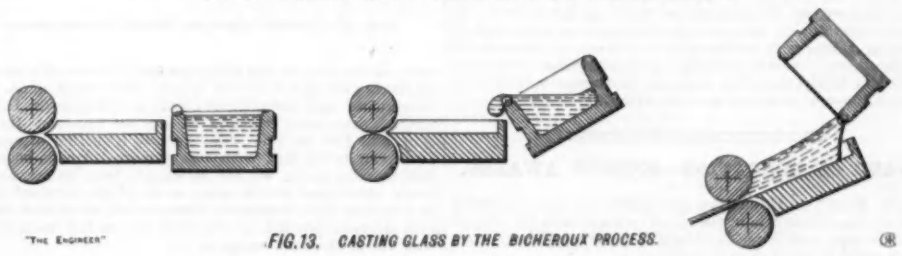


FIG. 12. CASTING GLASS BY THE OLDER STANDARD PLATE GLASS PROCESS.



"THE ENGINEER"

FIG. 13. CASTING GLASS BY THE BICHEROUX PROCESS.

Future Developments in Plate Glass Manufacture.—It is

difficult to predict what process of manufacturing plate glass will be regarded as standard practice in ten years' time. The Bicheroux process has already effected a profound change in the schemes for plate glass manufacture, although it only became commercially successful about 1924. It is, however, being rapidly installed in Europe and in America. A continuous process, such as that of Ford, would clearly give a greater production than a discontinuous process like the Bicheroux, but it is offset by difficulties in supplying, continuously, glass of uniformly high quality free from bubbles, streaks, &c., especially when the width of the sheet to be rolled approaches the size of sheet normally produced by the older casting process. So far as the manufacture of wind screens for motor cars is concerned, the continuous process is not one of excessive difficulty. The width of the sheet is comparatively small, but although much wider sheets have been rolled, the difficulties still to be overcome in producing high-quality plate are so considerable that the Bicheroux process has come as a relief to those manufacturers who were attempting to overcome them.

The fuel consumption of large pot furnaces is quite economical, and in order to increase the productivity of the Bicheroux process the size of the melting pots has recently been very greatly increased.

Whilst the successful development of the continuous rolling process of glass fed from tank furnaces still lags behind, continuous grinding and polishing processes are coming into widespread employment, of a character somewhat similar to that described in connection with the Ford process. Continuous grinding and polishing plant invented by Messrs. Pilkington Brothers is now being installed in some of the larger and newer installations in America. Its use, combined with the fact that by the Bicheroux process the amount of glass to be ground off is small, is resulting in the production of plate at a price very substantially less than that produced by the old casting method.

The contest, however, is by no means confined to the discontinuous process of Bicheroux and the continuous one in which glass is discharged from a tank furnace between rollers. Polished plate, prior to the invention of Lucas de Nehou, was prepared from blown cylinders, and this process continued in operation long after the casting process was initiated. In 1834 Messrs. Chance Brothers patented a device whereby selected window glass prepared from blown cylinders could rapidly be polished to give a perfectly smooth surface. This material, which constituted one of their important products for many years, was known under the name of "Patent Plate." Within the last five years a similar process has been adopted by the Libbey-Owens Sheet Glass Company, first of all in America and later at the European parent factory at Moll in Belgium. This glass drawn by the Libbey-Owens process is already flat, although not perfectly so as compared with polished plate. Selected drawn glass is now treated on polishing tables to produce perfectly flat glass and this material is now in considerable quantities on the market. A beginning has likewise been made in the treatment of the glass drawn by the Fourcault process. The result of polishing this type of glass is to remove the very slight waviness of its surface and the very faint lines which are known variously as "music" lines or "water silk" lines.

Normally, the glass drawn by the Fourcault and Libbey-Owens processes is thinner than plate, but greater thicknesses can be and are now drawn. Moreover, investigations are taking place of a variety of processes by which the thickness of the sheet drawn may steadily be increased. As has already been indicated, the glass melted in tank furnaces has not yet reached the same uniformly high quality as that which can be melted in pots, but this difference is almost certain to diminish as experience, based on investigation, accumulates. It may quite well be that in ten years' time this drawn glass, subsequently polished, will prove a very serious competitor to that produced by the process of rolling the glass; indeed, in the opinion of some manufacturers, this stage has already been reached.

Nor must we forget the assiduous attempts being made by a number of inventors to devise a satisfactory method of drawing sheet glass in various thicknesses by a downward flowing process, in which the flow of the sheet is controlled either by systems of weirs or by rollers. It may be that during the next ten years some one or other of these processes will be brought to a stage of commercial development. At the moment, however, these processes seem less likely than the drawing processes to take prominent place in commercial production.

BOARD OF EDUCATION—SCIENCE AWARDS.

THE Board of Education has published the following List of Awards as the result of the competition for Royal Scholarships and Free Studentships, 1930. (The names are in order of merit in each group):—

1. *Group A, Engineering* (*Number of Competitors*, 68).—Royal Scholarships: C. A. R. Pearce, S. H. G. Connock, J. A. Goode, L. R. Prout, and B. C. Caddy. Free Studentships: L. Lubetzki, R. P. Glover, and H. J. Revell.

2. *Group B, Physics* (*Number of Competitors*, 61).—Royal Scholarships: G. Mole, J. R. Tillman, A. D. J. Piesse, N. Laycock (tenure of award postponed), A. E. W. Austen, and W. F. Hilton. Free Studentships: E. H. Dock and F. C. Le Manquais.

3. *Group C, Chemistry* (*Number of Competitors*, 62).—Royal Scholarships: F. W. James, J. M. Ridgion, A. L. Latner, H. F. Rance, F. Townend, and B. W. Hirsh. Free Studentships: A. E. J. Went, A. J. Kidney, H. E. G. Emmett, and C. J. W. Hooper.

4. *Group D, Biology* (*Number of Competitors*, 16).—Royal Scholarships: J. Wilkinson and T. A. Oxley. Free Studentships: R. Hull and H. C. Mellor.

5. *Group E, Geology* (*Number of Competitors*, 6).—Royal Scholarship: G. E. G. Graham.

LANTERN SLIDES.—Marshall, Sons and Co., Ltd., of Gainsborough, ask us to announce that their several series of lantern slides illustrating oil engines, steam engines, boilers, road-making and other machinery, &c., are at the service of any lecturers to whom the slides may be of interest.

Armouring for Road Surfaces.

THE ever-increasing volume of motor traffic on our roads and the higher speeds which are prevalent with all classes of vehicles are providing road authorities with a serious problem. Although concrete and asphalt surfaces are being widely adopted, their ability to resist shock and abrasion and to prevent skidding is not in all cases adequate. For these purposes armouring is being resorted to, and one system which appears to give satisfactory results is being introduced by Estler Brothers, Ltd., South Molton-road, Victoria Docks, London, E. 16. In this system of armouring embedded bars of tough steel take the impact of falling loads and the grinding wear of rolling wheels as well as the abrasion due to the starting and stopping of vehicles.

The special feature claimed for the Estler armouring is that it maintains, almost indefinitely, the surface of

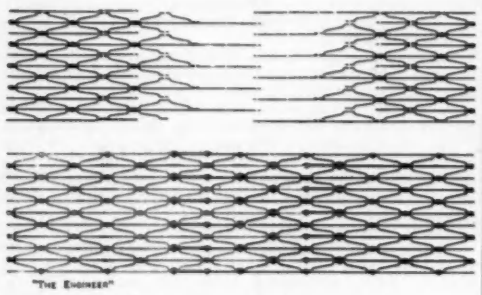


FIG. 1—SECTIONS OF ESTLER ARMOURING

the roadway of which it forms a part. This is made possible by a system of splicing which does away with all butt joints and unsupported bar ends, which sooner or later work loose under the shock of rolling loads. Sections of this trussed streamline armouring fabricated with the ends of the straight and reticuline bars projecting in alternate long and short lengths, as shown in Fig. 1, are assembled end to end with staggered offset lapped joints in all bars securely bolted. Sections adjoining laterally are assembled with their joints staggered and along the sides the sections are bolted together. The armouring thus assembled forms a continuous and unbroken trussed steel structure over the entire surface to be protected.

The armouring network levelled and anchored to the sub-flooring is then filled with concrete, mastic, composition or other plastic flooring, tamped or rolled into the

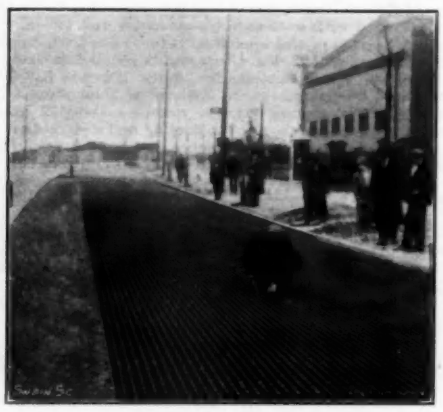


FIG. 2—LAYING ESTLER ROAD ARMOURING

mesh of the armour and the superfluous material is scraped off flush with the steel bar edges. The result is an even continuous and solid floor with a continuous bedded surface armouring varying in section between 1in. by $\frac{1}{4}$in. and $\frac{3}{4}$in. by $\frac{1}{4}$in. Fig. 2 shows a section of road in Liverpool being laid with this system. Roads made in this manner have, we are informed, been in service for many years, and the wearing away of the exposed edges of the steel bars is scarcely measurable, while the steel is still securely bonded to the concrete on the faces of the bars which show no corrosion.

Canadian Engineering News.

New Tube Mill.

A BRASS and copper tube mill is to be built as an extension of the plant of the Anaconda American Brass, Ltd., at New Toronto, Ontario. It has been decided to extend construction work, already under way on a large scale to incorporate facilities for manufacturing a complete line of non-ferrous seamless tubes. The plans call for a structure 400ft. by 80ft., one-storey, brick and structural steel construction, to cost with equipment about 500,000 dollars.

Large Gas Project.

Expenditures totalling about 2,000,000 dollars are planned by the Manufacturers' Natural Gas Company and the Steel Company of Canada to provide a new artificial gas supply for south-western Ontario. The project will be carried out in Hamilton, where a 10in. gas main will be laid from the plant of the Steel Company of Canada for a distance of several miles. The Manufacturers' Natural Gas Company has entered into an agreement with the Steel Company of Canada to handle gas from the steel company's coking plant. The proposed pipe line will carry the gas beyond the Hamilton city limits for distribution in south-western Ontario through existing pipe lines in mixture with natural gas. In carrying out the project, the Manufacturers' Natural Gas Company will lay the pipe line, build a compressor plant, a purification plant, a mixing plant, and a one-million-foot gasholder. The steel company will also spend a substantial sum in adjusting its present plant to take care of the contract.

Sodium Sulphate.

The utilisation of one of the numerous deposits of sodium sulphate in the province of Saskatchewan is now proceeding on a large scale, according to a statement recently issued by the Provincial Bureau of Publications reviewing the progress being made at the new plant of the Horseshoe Lake Mining Company on Horse Shoe Lake, near Ormiston, 60 miles south-west of Regina. The plant is now preparing about 100 tons per day, and additional units are being installed to greatly increase the output. Already 150 cars of 45 tons each have been shipped to the International Nickel Company. A feature of the operations is that the company has successfully solved the problem of de-hydrating the product. That was one of the chief obstacles in the past in developing a market for the product in Eastern Canada in competition with the synthetic product. The plant of the Horse Shoe Lake Mining Company is the joint enterprise of the Barium Reduction Company of Charleston, West Virginia, United States of America, and the International Nickel Company of Canada and is operating on a deposit containing millions of tons of natural sodium sulphate.

Ontario Radium Deposit.

The occurrence of radium near Wilberforce, Ontario, about 120 miles north-east of Toronto, has lately come in for a good deal of public attention, and it appears that efforts are to be put forward shortly to prove whether the vein carries sufficient quantities to be of commercial value. So far the deposit has been subjected to surface examination only, and it is now intended to undertake underground work. Several hundred acres around the discovery are held by a Toronto syndicate, the Ontario Radium Corporation, Ltd., and it is these interests who propose to undertake development. The Ontario Minister of Mines, Hon. Charles McCrea, has characterised the results so far obtained as hopeful.

Train Telephone Service.

Canada's first commercial two-way telephone service for passengers on moving trains has proved eminently successful after six months' service, during which there were no interruptions to calls or circuit time loss due to failure of any of the train telephone equipment. The telephones are being used daily for business purposes on the Canadian National Railway trains between Toronto and Montreal. During the first six weeks of operation about 60 per cent. of the calls handled were curiosity calls, 20 per cent. social, and 20 per cent. business conversations. Business calls now constitute about 65 per cent. of the total. The initial installation of the train telephone system has been operating daily since April 28th, 1930, on one train each way between Toronto and Montreal. The quality of transmission has been rated 95 per cent. perfect by the Bell Telephone Company, and on one call placed by a passenger to London, England, the perfect score of 100 per cent. was obtained.

Petroleum.

An outstanding feature of the half-yearly report on Canadian minerals is the growing production of petroleum which, though still small, is running at a rate of considerably over a million barrels annually. For the first eight months of 1930 the outupt was 898,802 barrels, against 690,165 barrels in the corresponding period a year ago.

Alcoa Power Plant.

The initial unit of one of the largest power development projects being carried out in Canada, that of the Alcoa Power Company at Chute-à-Caron, on the Saguenay River, in the province of Quebec, will probably be completed early next spring with an installed capacity of 260,000 horse-power. With a head of approximately 180ft., the power at this first unit will be generated by four turbines, each developing 65,000 H.P. By means of a large dam and a power canal close to the Shipshaw and Saguenay rivers, a second plant, capable of producing 800,000 H.P., is now under construction, so that a million horse-power will be available in the near future. Construction on the second unit is proceeding slowly, in keeping with the probable market for power within the next few years.

Automatic Train Line Couplings.

The Brotherhood of Railway Trainmen of Canada recently applied to the Board of Railway Commissioners for an order requiring the Canadian railways to install automatic train line couplings on their rolling stock. The Brotherhood's contention was that, since the Railway Act set forth that the installation of such appliances was mandatory on the railways, the latter should be compelled to comply with the Act without further delay. On the other hand, counsel for the railways submitted that no device satisfactory to all the conditions under which automatic train line couplings would be employed had yet been invented; consequently, no installation was possible at present. In the course of the hearing it was brought out that experiments are being conducted at Purdue University, Indiana, in order to ascertain if a suitable device can be discovered. A number of appliances have been submitted by various manufacturers, and some time must elapse before the results of the experiments can be made known.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

The Coal Situation.

THE position in the local coalfields at the time of writing may be considered fairly satisfactory, though a settlement has yet to be reached. While Shropshire miners have unanimously approved of a decision for a peace period to enable the owners to provide for the marketing of coal, Cannock Chase miners are to be consulted again on the questions at issue, particularly that of the spread-over. The situation is clearly shown by the statement issued at the conclusion of the recent conference of masters and men. This read: "The Cannock Chase Wages Board met to-day [December 6th], and in view of the Prime Minister's appeal, and the resolution passed by the Miners Conference as a result of the appeal, the meeting feels that this has so altered the position that it is necessary that the men should be consulted again, especially having regard to the fact that the position in the district is seriously prejudiced by the surrounding districts continuing to work on the spread-over." It is hoped that the outlook will so improve that when the conference is resumed on Saturday there will be a more satisfactory position to report. It is commented upon that the result of the ballot of the men on the spread-over has not been revealed, and it is assumed that the men have voted against it. In Shropshire the miners have, since Wednesday last, been working eight hours per day, with a five hours shift on Saturday and no reduction in wages.

Cannock Coal Profits.

The trading returns for the Cannock Chase and Pelsall coalfield for the month of October show that a profit of 2·2d. a ton was made on all coal produced, compared with profits of 3·65d. a ton in September and 1¼d. a ton in August. The miners' wages for December, if the spread-over is accepted, will remain at the minimum rate of 42 per cent. on the 1911 basis, but the industry's ability to pay is only 22·91 per cent. The owners' accumulated deficit is reported to be £1,410,109, against £1,380,756 a month ago.

Raw Iron.

There has been little, if any, change during the week in the pig iron market. In some cases foundrymen have placed orders to the end of the year, but few of them are prepared to order material for 1931. The bulk of the business done this week has related to supplies for immediate commitments, and has been put through at the recognised price levels. Northamptonshire blast-furnacemen are stated to be unable to dispose of the whole of their production, and a certain amount of material is going into stock. The outlook at local foundries is considered uncertain, while forgemen are notably poorly off for work. The tonnages of raw material bought by both classes of user are small. Continental pig iron appears to have vanished now from this market. It is said that prices have advanced and that makers no longer have hope or prospect of doing business here.

Steel.

The scarcity of orders, alike for finished and semi-finished steel, is causing Midland steelmasters much concern. Especially is that so, since specifications to take the place of existing contracts are small and irregular. It would appear from the demand for steel that business is very dull in the consuming industries in South Staffordshire. Of course, many users are now working their stocks very low, in view of the annual stocktaking normally carried out between Christmas and the New Year. Finished steel prices are strongly held at the level fixed by the Association. In the half-products branch, the recent weakening of prices has not proceeded further. Continental quotations for billets, bars, &c., continue to appreciate. Foreign small steel bars were quoted this week £5 10s., 2in. billets £4 11s. to £4 12s. 6d., and No. 3 Belgian iron about £5 8s. There is little business being done either in native or foreign steel.

Wrought Iron.

Orders for finished iron are very difficult to secure, and even in that department of the industry dealing with high-class bars for the engineering industry, it is impossible to find full-time employment for all hands. Individual firms on occasions have a rush of work, but that is usually accounted for by the fact that certain customers having run out of stock send in rush orders. Marked bar prices are upheld at £12 10s. per ton. Competition for the small amount of Crown bar business available is keen, and it is reported on 'Change in Birmingham this week that some ironmasters in this area have quoted less than £10 per ton, which has been regarded for some time past as the local minimum. Outside makers competing in this market are willing to do business at well below this figure. Stagnation persists in the common bar branch, Belgian firms getting the bulk of the orders. Wrought iron gas tube strip sells at from £10 17s. to £11 per ton, according to the size of order. The call for that material is considerable.

Galvanised Sheets.

The continuance of rolling at the local mills depends upon the receipt in the almost immediate future of new and substantial orders for galvanised sheets. Contracts have been completed so much faster than work has come in that some of the mills have practically no reserve of orders and plant will have to be laid idle unless matters mend. Demand at date is very quiet, and values remain unchanged on the basis of £11 5s. per ton for 24-gauge corrugateds.

Ironworkers' Wages.

Wages of ironworkers in this area, which are regulated by a sliding scale under the Midland Iron and Steel Wages Board, are to remain unchanged during December and January. They stand at 32½ per cent. above the base rate of 13s. 6d. The Board's ascertainment of selling prices during September and October showed a further slight fall in the average, but it was not sufficiently large to affect wages. Output showed an increase of less than 5 per cent. on the months of July and August—holiday months. Compared with the corresponding period of last year, output was down about 30 per cent.

Engineering Improves.

In one or two branches of engineering in this district an improvement in trade has been noticed during the past week or so. It does not amount to very much as yet, but gives ground for encouragement. On the electrical side recent big contracts have improved firms' outlook. A number of Midland firms engaged on stampings, pressings, and the manufacture of springs are well employed, and a few recent orders from abroad have eased the situation slightly in the edge tool industry. Rolling stock firms are steadily engaged, while constructional engineers report a continuance of quiet conditions.

Automobile Engineering.

Activity in the automobile engineering shops in the Birmingham, Coventry, and Wolverhampton districts has increased of late. Business, however, continues to be patchy. Light car manufacturers, particularly those producing popular models, are reasonably busy. Demand for medium and high-class models is steady, but heavy transport vehicles are not being called for as well as manufacturers would wish. Early in the New Year makers of accessories for the trade expect to receive larger orders than are at present falling to their lot.

Electrical Engineering.

Many Midland electrical firms are to benefit by the orders recently placed by the Central Electricity Board. The industry in this area is one of the most fortunately placed, thanks in part to the "Grid scheme, and the orders which are now coming to hand should ensure a continuance of regular work at the factories concerned, which include those of the General Electric Company, Ltd., of Birmingham, the English Electric Company, Ltd., of Stafford, and the British Thomson-Houston Company, Ltd., of Rugby.

Mechanical Engineers.

At the monthly meeting of the Birmingham Association of Mechanical Engineers in Birmingham on the 5th inst., Dr. O. F. Hudson delivered a most interesting and instructive address on developments of non-ferrous alloys. He spoke of the general trend of research, the production of metals of high purity, and the influence of small quantities of added elements, such as beryllium, magnesium, nickel, &c. The lecturer referred also to the latest developments in the extended use of electric furnaces for melting and heat treatment of metals, and to the improvement in the properties of alloys produced in such furnaces.

Unemployment.

The number of persons unemployed in the Midlands area according to the latest statistics is 199,060 wholly unemployed, 102,608 temporarily stopped, and 431 normally in casual employment, making a total of 302,099. This is an increase on the previous week of no less than 4909, and is higher by 142,138 than it was in the corresponding week last year. The total comprises 206,794 men, 5491 boys, 84,278 women, and 5536 girls. In the Birmingham area, where during December there is generally a fairly large amount of additional labour engaged in the distributive branches of trade, the figures so far this year continue to advance. The total of 51,898, the latest recorded, is an advance of 341 on the previous week's figures. At Stoke-on-Trent there has been a jump from 26,988 to 30,048.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Industrial Outlook.

IT is difficult to write at all hopefully at the present time of the immediate prospects before the engineering and allied industries in the Lancashire area. Of improvement in the important textile machinery branch there is not much actual sign, although quite recently sellers of foundry iron here reported having made somewhat better deliveries of the raw material to one or two firms engaged in this branch. Whether or not this fact signifies much actual improvement in the general position remains to be seen. Indications of expansion in either the home or overseas markets for textile plant are few. In exceptional instances, constructional engineers in Lancashire have fair order books, but the majority of them have dealt with relatively few inquiries lately, and actual new orders of any weight have been a rarity. The brightest spot, as it has been for several years, is still the heavy electrical engineering branch, and the leading firms in this department manage to keep going satisfactorily. Locomotive engineers as a whole, however, are much less busy than they were six months ago, and boilermakers, due largely to the long-continued depression in the home textile industry, are short of work. Departments concerned with the manufacture of motor car parts are moderately active. Much hope for the future of the Lancashire heavy industries lies in the successful development of the Lancashire Steel Corporation, which was formed early this year. This huge concern, however, has not yet got into its stride, and until its plans for rationalisation and expansion become fully operative within the next year or two, the industrial and technical advantages of the merger will not be completely realised.

£100,000 Gas Plant Nearing Completion.

It is expected that the new gas plant which has been under construction for the Mossley Corporation for about three years, will be completed in the near future. The total cost has been in the neighbourhood of £100,000, and large economies in the cost of handling raw materials, as well as appreciable improvements in manufacturing efficiency, are looked for. The formal opening of the works will take place shortly.

Non-ferrous Metals.

Weakness has been a general feature of the market for non-ferrous metals during the past week, all varieties having been more or less seriously affected. At one time speculative influences sent up standard copper prices to just over the £50 mark, a level which has not been touched since about the end of June, but the inevitable reaction was severe and extended into the early days of the present week. Requirements of consumers in this section seem to have been covered for the time being and buying for industrial use has been on quiet lines. In tin, also, a poor demand coupled with a statistical situation which is far from "bullish, has exerted a depressing effect on values, though they are still fractionally above the lowest point touched by this metal during the past few months. The possibility of the formation of a zinc cartel, with its attendant control of production and supplies, has been a factor in the spelter market of late, but the failure of negotiations with this end in view seriously reacted on prices, forcing them down to new "lows." Ground has, likewise, been lost in the case of lead, available supplies of the metal being more than sufficient to cover the present limited demand.

Iron and Steel.

A moderate movement of pig iron has been reported here, with a certain amount of business placed for delivery over the first month of next year. The fact that deliveries into consumption at Lancashire foundries are maintained at a slightly better level than about a month ago, is one relatively bright feature of an otherwise generally depressing market. With regard to quotations, Midland brands—Staffordshire and Derbyshire—are at 69s. 6d. per ton, including delivery to users in the Manchester price zone, with forge iron at 5s. less. The market for Scottish iron is not too strong, and offers are being made at from 90s. 6d. to 91s. per ton, with West Coast hematite at about 84s., including delivery equal to Manchester in each case. Bar iron is steady at £10 5s. per ton for Lancashire Crown quality, and £8 15s. for No. 2 material, but the aggregate tonnage moving in this section is very small. New buying in the steel market, after three months or more of almost uniform dulness, shows no indication of expanding, and almost all rollers offering here report extremely limited sales, with interest among users concerning forward transactions almost non-existent. Small re-rolled bars and also boiler plates are on the easy side, but in other respects steel prices are unchanged.

BARROW-IN-FURNESS.

Hematite.

The market has been so quiet as regards hematite pig iron that stocks have gone on increasing week by week, until they have assumed large proportions, and the time has come when producers are compelled to consider the position. At Barrow the continued idleness in the steel departments has meant much iron going into stock, and the result is the possible stoppage this week of the two furnaces until stocks are down again. In other districts in the North-West stocks are increasing and it is possible that there may be further stoppages. Whether the furnaces will be damped down or put out is not known yet. This stoppage does not come as a surprise, for it has been known for some time that production at all works has exceeded the demand. Generally speaking, trade is very flat. The home demand is thin and business with the Continent is only very moderate. There were shipments last week overseas, but the tonnage was not heavy comparatively speaking. American orders are scarce Native iron ore mines are naturally affected by this restriction, as also are orders for foreign ores. The iron ore trade is really a reflection of the iron trade. Steel is very dull, Barrow is still idle, so far as the rail department is concerned, and at Workington the rail mill is running this week, but will, very likely, complete contracts by the week-end.

LATER.

The Barrow Steel Company will this week-end, owing to the keen depression in the iron trade and the large accumulation of iron stocks, damp down the two furnaces that have been operating at Barrow. The hoop works will remain active. The Barrow Steel Works have been idle since last July.

Shipbuilding.

Vickers-Armstrongs, at Barrow, have completed the "Otaio," a large steamer to the order of the New Zealand Shipping Company, and she left for her trials this week. She is 490ft. overall, and has a deadweight of 12,300 tons. Her speed is between 15 and 16 knots, and she will be the biggest vessel in the New Zealand Company's service.

SHEFFIELD.

(From our own Correspondent.)

October Steel Production.

THE statistics of iron and steel production for October have now been issued by the National Federation of Iron and Steel Manufacturers, but I am unable on this occasion to extract from them the individual figures of steel relating to the Sheffield area, as they are given in combination with those of the West Coast. While the two

sets of statistics, together, show a small increase, however, they do not indicate any progress on the way to a normal state of things. The total output for October was 83,700 tons—including 28,700 tons of acid and 43,100 tons of basic—as compared with 75,700 tons in September, and 135,500 tons in October last year. It is doubtful whether any advances have been made in the Sheffield area since. Reports which came to hand week by week during November, as well as those received during the present month, have uniformly showed that the prevailing depression is unrelieved. During the past week, one idle furnace has been restarted, but that was balanced by the closing of one that was in commission, so that the position as regards aggregate output remains unchanged. There are few large orders about, and work comes in so intermittently that it is difficult to see far ahead.

In Lincolnshire.

The Lincolnshire production returns for September showed up much better than those of Sheffield, but in October they were badly down. The output for that month was only 50,100 tons, as against 65,700 tons in September and 69,900 tons in October of last year. The pig iron production in October was 54,200 tons, as compared with 79,400 tons in October, 1929. There are no indications yet of the position in that area being more satisfactory.

Departmental Details.

On the heavy manufacturing side, few branches are at all well employed. Some heavy forgings are being made for hollow rolled drums, the production of which is a very useful branch of trade. The railway steel department is one of the slackest, the demand for axles, tires and springs still being regulated by a policy of strict economy, both at home and abroad. Not much is being done in the building of wagons for private owners. There has been a falling off in the requirements of the shipbuilders, but John Brown and Co., Ltd., are favourably placed in that department, owing to their receipt of the order for the building of the giant Cunarder. In the finished sections generally, the booking of new business has tapered off, but the amount of work passing through the shops has been maintained, as the completion of orders on hand is being accelerated in order to ensure delivery before the Christmas suspension—which, by the way, promises, in many cases, to be of longer duration than usual. Owing to the difficulties in the coal trade, there has been a fall in the sales of colliery tools and equipment, orders being held in abeyance by colliery owners in view of the uncertainty of the situation. There is little change to report in the various special branches. Both stainless steel and its kindred materials, and supplies for the automobile trade, represent substantial volumes of trade, though not equal to past standards, while the demand for cold-rolled steel and strip shows a considerable decline. There is fairly brisk business in the better grade wires. Considerable quantities of these Sheffield products have, for some time, been taken by the ropemakers, who have enjoyed a fair amount of employment in spite of the unsatisfactory condition of the coal trade. Overseas business in British wire rope and cable is on a substantial scale. In the cheaper wires, quiet conditions prevail, and many workers are on short time.

Prices.

It is anticipated that the new year will see an alteration, in a downward direction, in the prices of crude steel, which will, to some extent, be accounted for by the cheapness of scrap. Although scrap merchants are at present unable to report any signs of improvement in demand, their material is cheaper than it has been for a considerable time. Another factor that may make for cheaper steel is that costs of production have been declining slightly during most of this year, and the benefits of derating have also to be taken into account.

The Dyestuffs Act.

Not only has Sheffield to fear a serious fall in its cutlery trade when the Safeguarding Duty is allowed to lapse, but it has another cause of alarm in the posibility of a repeal of the Dyestuffs Act. Mr. A. J. Grant, president of the Sheffield branch of the National Union of Manufacturers, at the annual meeting of the branch last week, said that that repeal would be the most criminal thing that any Government could do. Without any rhyme or reason, without any complaints from anybody, but merely because of the superstitution of the present Government that any sort of safeguarding duty must be removed, the Act was to lapse. The Dyestuffs Act, he added, had indirectly affected Sheffield. In the process of dyeing, vessels were used which had to stand very high temperatures. His firm—John Brown and Co.—had made a number of these vessels, and the capital expenditure on the plant to produce them must have been very great indeed. With the lapsing of the Act, not only the men in the dyeing industry, but also a great many men who had been employed in making the very expensive and elaborate machinery required would be thrown out of work.

An Ironworks Acquisition.

The well-known works of the Carnforth Hematite Iron Company, Ltd., Lancashire, have been acquired by Thos. W. Ward, Ltd., Sheffield. The concern, which was established in 1865, is not by any means obsolete, and would not have come into the market but for the depressed condition of the iron and steel trades. The purchase includes the blast-furnaces and plant, limestone quarries and works site, which is freehold, with 8 miles of railway, but is exclusive of the houses and cottages. The three blast-furnaces have had a weekly capacity of over 4000 tons of high-class hematite pig iron, and the quality of the limestone quarried was unrivalled for blast-furnace use. Messrs. Ward's intentions are at present unknown, but it is probable that the fate of the works will depend on the result of future developments towards safeguarding.

A Good Order.

Ambrose Shardlow and Co., Ltd., of Sheffield, have received an order from the Air Ministry for the supply of a large number of micrometers. This firm has received orders in the past for Government work, both from the Admiralty and the Air Ministry, but that just received is the biggest it has had from the latter Department.

A New Wire Rope Cutter.

A handy portable cutting machine, for the cutting of wire ropes, chains, and iron and steel bars, has recently been introduced by the Hardy Patent Pick Company, Ltd., of Sheffield. It is distinguished by a combination of ratchet and excentric movement, which is stated to be unique and which gives enormous cutting power. Wire ropes of up to 1¼in. in diameter, steel and iron bars and chains up to 1in. diameter, can be cut in a few seconds. The castings are made of steel, all parts subject to wear being case-hardened, while the cutters are of a special alloy steel to ensure satisfactory wear. The design is simple, the machine operates with great ease, and, being mounted on a wheeled tripod, it can easily be moved about. It is described as being an excellent time-saver to colliery and associated concerns.

Trade with Russia.

Possibilities of extending Sheffield's trade with Russia—which was formerly one of the city's best markets for saws, files and other tools—are being inquired into by local manufacturers. They are endeavouring to persuade the Government either to alter its policy regarding the granting of extended facilities for the trade, or to ask Arcos to offer orders on shorter term credits than at present. Two Sheffield manufacturers who desire to do business with Russia in files and drills waited last week upon Mr. Gillett, the Secretary for Overseas Trade, and discussed with him extended credits for the business, on the guarantee of the British Government. Mr. Gillett indicated how they should seek such facilities.

Cutlery and Plate.

In the cutlery and plate trades, late orders for the Christmas sales are still coming in from the shopkeepers in London and the provinces, but they are mostly of small dimensions, and there is none of that rush of work which used to characterise the closing weeks of the year. The home market has proved a fairly good one this season for several firms who produce a good article at a moderate price. There has been an average demand for high-class pen and pocket knives, though the trade is not what it formerly was, as the number of penknives carried by people has fallen owing to the vogue of the propeller pencil. Large quantities of these knives are being distributed in return for coupons, and this system of disposal also calls for the production of good supplies of small plated goods. There has been a noticeable falling off in the sales of expensive ivory-handled table cutlery. Export trade has quietened down after the fulfilment of the Christmas orders, and shows a falling off as compared with previous years, but it still maintains a fair level. The firm of George H. Lawrence, Ltd., of Sheffield, which recently received an order for 500,000 "Laurel" safety razor blades for South Africa, has since booked another order of the same size for the same destination. The retail price of the blades in this country is 1½d. and 2d. each, so that the financial value of the two orders is considerable.

NORTH OF ENGLAND.

(From our own Correspondent.)

Castings for New Cunarder.

THE contract for the huge structural castings to be fitted to the new Cunard liner, which is to be built by John Brown and Co., Ltd., at Clydebank, has been awarded to the Darlington Forge Company. The work to be undertaken by the Darlington firm is the manufacture of the castings for the stern frame, shaft brackets, and the rudder, with a total finished weight of over 500 tons, and necessitating the casting of some 800 to 900 tons of molten steel. The Darlington Forge Company was responsible for the castings and forgings for many ocean liners, including the "Mauretania," "Aquitania," "Carmania," "Olympic," and "Britannic." The castings for the new liner far exceed in size and weight anything which has hitherto been made, either in this country or abroad. The details of the castings are:—Overall length of stern frame, 112ft.; approximate finished weight of stern frame, 180 tons; approximate finished weight of the four shaft brackets, 215 tons; approximate finished weight of the rudder frame, 112 tons. Even with the special equipment which the Darlington Forge possesses for dealing with such work, much has had to be done in the way of special preparation in the moulding shops, and large annealing furnaces have had to be extended or rebuilt for the safe annealing of the castings; while transport of the castings from one department to the other will call for special arrangements. The work will occupy some eight or nine months, and the carrying of these castings to Glasgow, partly by rail and water or by road, will constitute a new record in heavy transport.

Cleveland Iron Trade.

The Cleveland pig iron trade continues quiet. The outlook, however, is regarded as rather less discouraging, and there is a growing feeling that transactions are likely to expand materially early in the New Year. During the past week there have been bigger shipments of iron from the Tees, but these fluctuations seem to be spasmodic, and there is no real broadening of the basis of export business. However, in a few cases consumers are beginning to discuss purchases for next year. Prices are unchanged, No. 1 Cleveland foundry iron being 66s.; No. 3 G.M.B. 63s. 6d., No. 4 foundry 62s. 6d., and No. 4 forge 62s.

Hematite Pig Iron.

There is no material change in the position of the East Coast hematite pig iron trade. A moderate home business continues, and makers and merchants report occasional small transactions with customers abroad. Ordinary qualities are in the neighbourhood of 71s., and No. 1 quality is at a premium of 6d. per ton.

Ironmaking Materials.

Foreign ore consumers are off the market. Best Rubio is 16s. c.i.f. Tees, but sellers state that they will not commit themselves ahead at that figure. Blast-furnace coke continues in ample supply, and in only moderate request. Good average qualities are offered at 17s. delivered at the works.

Manufactured Iron and Steel.

Manufactured iron and steel, as well as semi-finished materials, are slow of sale, but quotations are upheld. Continental semi-finished steel is offered much less freely than of late. Export sales of finished steel are difficult to arrange, but some expansion of overseas demand is expected. Constructional producers hope to secure more contracts, and as home railways have not bought material for renewals at all extensively for some time past, orders for rails, &c., may be placed in the near future. Some slight improvement in sales of galvanised sheets is reported.

The Coal Trade.

The week's idleness in the Scottish coalfield gave a decided fillip to the Northumberland and Durham coal trade. Fitters secured some substantial new and unexpected trade, and this, combined with the lower output for the month owing to the holidays, has imparted a firm tone to the market, although recent high prices have not altogether been maintained. Producers now find themselves in a very satisfactory position to the turn of the year. Northumberland steam coals are fully taken up at 13s. 6d. to 14s. There are full loading turns for most classes of steam coals up to Christmas, and some descriptions are keenly sought after. The Durham steam coal position has also gained strength, and 14s. to 15s. is asked by holders of small parcels. Small coals, however, show no special features, and buyers can cover at recent values of 9s. 6d. for ordinary and 10s. 6d. for specials. A good tone prevails in the Durham gas coal section. Best qualities are in brisk demand, and a very limited supply is available for December; 15s. can be easily obtained. Secondary gas coals maintain a steady tone at 12s. 9d. to 13s. Special qualities are so heavily sold that for any small parcels 16s. 6d. is bid. The Durham coking unscreened position is firm. Producers are well booked to the end of the year, and quote steadily at 13s. to 13s. 6d. Best quality bunkers are irregular, as the foggy weather has delayed many tonnage arrivals and thrown a few prompt parcels on the market. The general tendency, however, is steady for good ordinary at 13s. and best at 14s. Several new inquiries are circulating for gas coke, and with the output already well booked, new buyers have to make up their requirements by obtaining many small parcels. Best gas coke is at a minimum of 21s. 6d. Patent oven coke is in good supply, and quoted just steady at 17s. to 17s. 6d. Beehive and superior foundry coke are offered at 24s. to 28s.

SCOTLAND.

(From our own Correspondent.)

Dull Outlook.

MARKETS on the whole remain dull. Very little business of any real importance has been reported of late, and the only item of particular interest relates to the starting of work on the new Cunarder. Generally speaking, overseas buyers show little interest, and home markets are affected by dull conditions in all industries. Production was not affected to any extent by the coal trade stoppage, but some anxiety must be experienced in view of the fact that the arrangement is only a temporary settlement. Prices have not been affected, and keen quotations for most products are the rule, but there is less appearance of weakness, no doubt due to the steadier levels obtaining on the Continent at present.

Steel.

Inquiries have been slightly better of late, but business is slow to materialise, and producers continue short of orders, both on home and export account. Orders for heavy steel are particularly scarce, and many works are only partially employed. Sheet makers are a little better off, the demand for galvanised descriptions having shown some improvement since the latest cut in prices. Tubes, however, are still a very dull market.

Locomotive Orders.

The Central African Railway has placed an order for thirteen locomotive—duplicate—boilers with the North British Locomotive Company, Ltd., Glasgow. The same firm has an order on hand for six locomotives for the same railway.

Iron.

Conditions in the iron trade remain unsatisfactory in the extreme. Bar iron and re-rolled steel bars are poorly specified, the actual turnover being as low as at any time since the depression set in. Owing to costs, bar iron suffers in competition with steel, while re-rolled steel bars are considerably dearer than continental products at £7 7s. 6d. home and £7 5s. per ton export. Similarly, pig iron has to meet keen competition in the form of imports from India and the Continent, also consignments from England. The production is confined to the output from ten furnaces and is quite sufficient to meet all demands.

Scrap.

Business in scrap is more or less of a hand-to-mouth description, with prices fairly steady round about 50s. per ton for heavy steel and 60s. per ton for cast iron machinery scrap.

Coal.

So far as the export trade was concerned, business was, of course, rendered impossible, owing to the stoppage at the mines. The production has been curtailed for some time, and with the collieries reserving supplies for their own use and against home contracts, and land sales, nothing was available for shipment, apart from very small lots at prohibitive prices. Even at the time of writing, buyers are inactive, waiting, it is understood, until the output is improved and prices are normal. Aggregate shipments amounted to 126,359 tons against 244,970 tons in the preceding week and 304,471 tons in the same week last year. During the stoppage household fuels rose in price to 3s. per cwt., but already prices are almost normal again.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Negotiations.

ALTHOUGH no great progress has been made towards a permanent wage agreement for this district, discussions which have taken place have shown that so far there is a disposition on both sides to display a certain amount of reasonableness, and one can only hope that this spirit will continue, though some vital problems have yet to be tackled. Since I wrote a week ago, sufficient has happened to allay the fear of traders that there will be any serious trouble in the industry, at least for a month or two. The National delegate conference of the Miners' Federation went back on its previous decision regarding the "spread-over," and referred the matter to the districts, at the same time condoning the action of the South Wales miners' delegate conference which had previously agreed to this method of working. The executive of the South Wales Miners' Federation met on Saturday last, when it was decided to call a coalfield conference for Saturday next, at which the delegates attending will be called upon to consider the recommendation of the executive that the Prime Minister's suggestion should be accepted, viz., that the industry should be given a chance to get its reorganisation scheme under the Coal Mines Act working effectively by approving the "spread-over" for a temporary period of three months without any reduction of wages. The executive of the South Wales Miners' Federation makes this recommendation with the proposal that the "spread-over" should be worked on a weekly basis. The workmen's representatives put forward the proposal for a three months' truce, with no wage reductions, when they met the owners at a special meeting of the Coal Conciliation Board at Cardiff on Tuesday. The reply of the owners' representatives was to make an offer to extend the existing terms under the "spread-over" until the end of January, which means that wages would be continued at the same level for the same amount of work as operated before the passing of the Coal Mines Act. One difficulty in this connection cropped up, as under the present "spread-over" of hours, the workmen are liable to lose one day per fortnight. One suggestion put forward, but rejected, was that 7¾ hours should be worked for five days in the week and 5¼ hours on Saturday. Ultimately, further negotiations were left in the hands of the joint subcommittee dealing with the question of the new agreement, and this sub-committee will meet on Monday next.

Coal Export Activity.

Returns of shipments at the leading ports in this district last week were somewhat disappointing, but it is not surprising to find a slight reduction compared with the previous week, for tonnage was very much delayed in making its passages as the result of fog and bad weather. The total shipments, according to the Great Western Railway Company's figures, were 515,000 tons, as against 522,500 tons for the preceding week and 555,898 tons for the corresponding period of last year. There is this satisfaction, however, that loading pressure will be much heavier from now right up to the Christmas holidays, as, apart from the backward tonnage due to come along, chartering operations last week were heavier than for many weeks past, and there is still a steady demand. Foreign coaling stations are filling up more, and quite a number of small orders have come along for cargoes for prompt loading. A number of collieries are well stemmed for the remainder of the month, though it is singular that several collieries producing the best grades of Admiralty large coals are temporarily in an easy position, and could do with prompt orders. Nothing much has developed in the way of contract operations, and if there is a three months' truce in the coalfield, it only means in one sense prolonging the period of uncertainty, and it will possibly have the effect of making foreign buyers proceed on the hand-to-mouth principle instead of buying ahead. In the case of the Egyptian State Railways' requirements of 155,000 metric tons of locomotive coals for delivery over the early part of 1931, the date upon which tenders have to be in has been postponed to the 30th inst., doubtlessly with a view to being able to see clearly what the prospects are of peace prevailing in the coalfields of this country. Whether the position will be more definite then, remains to be seen. The Spanish Navy has bought a couple of cargoes of Admiralty coals for early delivery, and the Swedish State Railways have invited prices for 44,000 tons of engine coal, and 2000–3000 tons of bunker coals. The British Admiralty is in the market for 50,000 tons of washed coals, and there is a Belgian inquiry for supplies of duff coals. The Crown Agents for the Colonies have an inquiry for 13,000 to 14,000 tons of steam coal for the Palestine Railways, while the Greek Government has asked for prices for a cargo of 5500 tons for delivery at Salonika. There must, however, be considerable uncertainty regarding the extent to which business can be secured in the future, particularly in the face of the reduced railway rates which are to operate and facilitate the competition of both German and Polish coals for the North Sea and Italian trades.

Traffic Returns.

The Great Western Railway Company has issued its statistics regarding the traffic at the ports in this district under its control for the four weeks ended November 23rd last. The figures are not very satisfactory, as imports totalled 314,909 tons, as against 410,690 tons for the preceding month and exports came to 2,179,936 tons, as against 2,239,936 tons for the previous month. Taking the figures for the whole of this year to November 23rd, practically eleven months, imports amounted to 4,367,671 tons, compared wtih 4,696,914 tons for the corresponding period of last year; while exports totalled 27,378,027 tons, compared with 29,935,440 tons, thus giving an aggregate traffic of 31,745,698 tons, as against 34,632,354 tons for the same period of 1929, a reduction of nearly 3,000,000 tons.

Works Resume.

Operations were resumed on Monday at the Upper Forest and Worcester Tin-plate Works, Morriston, after an idle period of five or six weeks. By the end of this week it is expected that work will be provided for about 1650 workers. The bar mills at the Duffryn Works, Morriston, were also expected to restart on Monday last. They have been idle since September last. This resumption means that about 200 men will be employed.

Current Business.

The coal market has a slightly steadier tone in some directions, but on the whole it is marked by irregularity. Busier conditions certainly prevail, though standing stocks of large coals are heavy, and if exporters cannot obtain one particular coal they can satisfy their requirements in others. Smalls are still excessive, but sized productions are short, and are firm. Patent fuel and coke present no new feature, but supplies of pitwood for prompt delivery are scarce, and the market is about 28s. to 28s. 6d. The Marketing Association has advised the colliery companies that it has received the district allocations for the quarter ending March next. It is reported that the total represents about a 12 per cent. reduction upon the output figures for the corresponding period of this year. Quotas cannot, however, be allocated to individual collieries until the standard tonnage has been fixed for all members of the Association.

B.E.S.A. SPECIFICATIONS.

BRONZE WIRE AND CADMIUM COPPER WIRE.

A slight revision of the above specification has recently been issued by the British Engineering Standards Association. It mainly affects the resistances per mile of bronze wire. This revision has been found necessary in view of the fact that since the issue of the original specification the resistance per mile of bronze wire manufactured to the specification has been found to be considerably lower in some instances than the resistance of wire manufactured heretofore, this probably being due to a certain amount of cadmium being added to the bronze billets. Bronze wire having these characteristics is unsuitable from the point of view of the General Post Office, since trouble would inevitably occur when balancing A and B lines for resistance in the eventuality of coils of wire from different manufacturers being used on the same work. As a safeguard against this state of affairs, a minimum value for the resistance per mile for this class of wire has been inserted in the specification in addition to a maximum value.

As regards the cadmium copper wire referred to in the same specification, the same need for a minimum resistance does not arise, since the variation in resistance from the standard value is, in practice, not very large.

Another modification to the specification relates to the weight of coils of the 40 lb. wire. The revised weights allow a wider latitude to the manufacturer in making up his coils, thus largely overcoming the question of waste, which has in the past been found to be a somewhat serious matter in the case of this particular size of wire.

The specification in question—B.S. Specification 175—is one of a series of specifications for Overhead Line Wire Material for Telegraph and Telephone Purposes, this series being published in a single volume as Specifications Nos. 174–181, and may be obtained from the Publications Department, British Engineering Standards Association, 28, Victoria-street, London, S.W. 1, price 2s. 2d. post free.

Those who already possess a copy of the specification may obtain a copy of the revision slip—Reference C.C. 2280—for B.S. Specification No. 175 free of charge on application, enclosing a stamped envelope.

LAUNCHES AND TRIAL TRIPS.

CHEYENNE, oil tank motor vessel; built by Palmer's Shipbuilding and Iron Company, Ltd., to the order of Anglo-American Oil Company, Ltd. Engines, oil, Doxford type; trial trip, November 14th.

FOYLEBANK, twin-screw motor vessel; built by Harland and Wolff, Ltd., to the order of Messrs. Andrew Weir and Co; dimensions, 425ft. by 57ft. by 38ft. 7in.; to carry cargo. Engines, oil, Harland-B. and W. type; constructed by the builders; trial trip, November 14th.

NORVINN, motor-driven oil tanker; built by Barclay, Curle and Co., Ltd.; to the order of Messrs. Rasmussen Og Moes Rederi, A/S., Norway; dimensions, 420ft. by 58ft. 6in. by 32ft. 3in.; to carry oil in bulk. Engines, oil, Barclay, Curle-Doxford type; constructed by the builders; trial trip, November 14th.

SWIFT, steamship; built by Workman, Clark (1928), Ltd., to the order of General Steam Navigation Company, Ltd.; dimensions, 225ft. by 35ft. by 21ft. 6in.; to carry cargo. Engines, triple-expansion; constructed by the builders; trial trip, November 17th.

POLARTANK, motor vessel; built by Barclay, Curle and Co., Ltd., to the order of Messrs. Hvalfangerselskapet Polaris A/S., Norway; dimensions, 420ft. by 58ft. 6in. by 32ft. 3in.; to carry oil in bulk. Engines, oil, Barclay, Curle-Doxford type; constructed by the builders; trial trip, November 18th.

SKOTAAS, twin-screw motor vessel; built by Caledon Shipbuilding and Engineering Company, Ltd., to the order of Aktiebolaget Gotaverken Goteburg, Sweden; dimensions, 449ft. 10in. by 59ft. by 35ft. 6in.; to carry cargo and oil. Engines, oil, which will be installed when hull reaches Goteburg; constructed by Aktiebolaget Gotaverken; launch, November 18th.

BRITISH SPLENDOUR, motor vessel; built by Palmer's Shipbuilding and Iron Company, Ltd., to the order of British Tanker Company, Ltd.; dimensions, 456ft. by 59ft. 3in. by 33ft.; to carry oil in bulk. Engines, oil, Doxford type; constructed by the builders; launch, November 20th.

LEIESTEN, single-screw motor ship; built by Sir W. G. Armstrong, Whitworth and Co. (Shipbuilders), Ltd., to the order of Skibsaktie Selskapet "Leiesten" of Tonsberg, Norway; dimensions, 408ft. by 54ft. 9in.; to carry 9000 tons. Engines, oil; constructed by the builders; trial trip, November 20th.

NORBRIS, motor vessel; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of the South Sea Whaling Company, Sandefjord, Norway; dimensions, 475ft. by 59½ft.; to carry oil in bulk. Engines, oil, Wallsend-Sulzer type; constructed by the Wallsend Slipway and Engineering Company; trial trip, November 20th.

PERSONAL AND BUSINESS ANNOUNCEMENTS

HOLDEN AND BROOKE, Ltd., of West Gorton, Manchester, ask us to announce that, from to-day, their district agencies in the Lancashire, Yorkshire, and North-East Coast districts will be superseded by a sales service in the hands of Mr. S. N. Clift, one of their head office technical engineers, with headquarters in Manchester.

THE ENGLISH ELECTRIC COMPANY, Ltd., of Queen's House, Kingsway, London, W.C. 2, asks us to announce that its publicity organisation, comprising the publication, advertising, and stationery departments, has been transferred to its works at Stafford, and requests that all future communications concerned with those departments shall be addressed to the English Electric Company, Ltd., Stafford.

CONTRACTS.

THE Minister of Transport announces that he has accepted a tender submitted by Henry Robb, Ltd., of Leith, for the construction of a steam tug for the Caledonian Canal. The vessel will be constructed with a view to its use on the canal as a tug and also an icebreaker.

THE ENGLISH ELECTRIC COMPANY, Ltd., has received from the Leyton Borough Council an order for fifty double-deck tramcar bodies, which are to be generally similar to the fifty bodies recently completed for the London County Council by the same company. The value of this order is approximately £90,000.

BLACKSTONE AND CO., Ltd., of Stamford, have recently received orders for seventeen "Unchokeable" pumps of various sizes for sewage works in this country, Port Elizabeth, and New Zealand. The same company has also received orders for portable pumping sets embodying "Unchokeable" pumps from the Rural District Councils of Cuckfield and Teddington and from the Royal Engineers.

THE CLARKSON THIMBLE TUBE BOILER COMPANY, Ltd., of 613, Australia House, Strand, London, W.C. 2, has received orders from Robert Thompson and Sons, Ltd., of Sunderland, on behalf of foreign owners, for two silencer boilers of a novel type. They are to be somewhat similar to the "duplex" boilers which we recently supplied for French motor trawlers, with the exception that the oil-burning unit is replaced by electrical heating elements. The combination of the exhaust gas silencer boiler with the electrical boiler has never before been attempted.

THE CENTRAL ELECTRICITY BOARD announces that it has placed further orders, amounting to about £750,000. They include switchgear for the Central England, Mid-East England, North-East England, South-East England and South-West England and South Wales schemes, orders for which are to be filled by the British Thomson-Houston Company, Ltd., of Rugby; Ferguson, Pailin, Ltd., of Manchester; the General Electric Company, Ltd., of Birmingham; Johnson and Phillips, Ltd., of London; the Metropolitan-Vickers Electrical Company, Ltd., of Manchester; and A. Reyrolle and Co., Ltd., of Hebburn-on-Tyne. Orders for transformers for the South-East England scheme have been placed with the Brush Electrical Engineering Company, Ltd., of Loughborough; and the English Electric Company, Ltd., of Stafford. Siemens Bros. and Co., Ltd., Woolwich; and Enfield Cable Works, Ltd., London, have been given orders for cables required in connection with the South-West England and South Wales and the Mid-East England schemes respectively. An order for the secondary transmission lines for the Mid-East England scheme has been placed with the J. L. Eve Construction Company, Ltd., London.

INSTITUTION OF MECHANICAL ENGINEERS.—There was a very happy gathering at the Engineers' Club, Manchester, on the occasion of the annual dinner of the North-West Branch on Thursday, 4th inst. Mr. H. L. Guy, Chairman of the branch, presided, and there was a very good attendance of members and friends, including the President, Mr. L. St. L. Pendred, and Major-General Sir Phillip A. M. Nash. Sir Phillip proposed the toast of "The Institution," and in the course of an interesting speech referred to the activities of the Institution and forecast future progress in transport by rail, road, sea, and air. The toast was responded to by the President of the Institution in his own irresistibly humorous manner. He asked them to remember that such a great Institution as theirs must have a nerve centre—a head at which it could direct and co-ordinate the activities of the members of the branch, and he submitted to them that it would always be wise to foster and encourage the headquarters in London. It was possible that the best work would always emanate from the branches. But in London they might hope to have discussions on subjects which had no local interest, but which belonged to the whole branch of mechanical engineering. It sometimes seemed to him that the effect of their branches was to cause decentralisation, and he thought that some day they would perhaps go back to the earlier days, when conventions for two or three days were a regular order of the proceedings of the Institution. Captain Beames proposed the toast "Our Guests" in a breezy speech, while Brig.-General M. Mowat, who replied on behalf of the guests, maintained the happy tone of the earlier speakers. The toast of "The Chairman" was proposed by Mr. R. L. Gregson, Chairman of the Graduates' Section, in a brief speech, in which he eulogised the splendid work which Mr. Guy had done. In reply, Mr. Guy said they were specially proud of the local Graduates' Section for the honour which it had brought to the branch by again securing two of the awards offered for graduates' papers by the Institution. He said it was perfectly true that their branch desired to move quickly, and they had initiated a programme of development which they thought would add to the efficiency of the Institution. They had made many experiments, and those experiments had achieved a very gratifying measure of success. He did ask those in London to begin to appreciate that all that had been done for the good of the Institution, that the Institution might renew its youth and might adjust itself to changing conditions. A collection was taken during the proceedings for the Benevolent Fund of the Institution.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	17/9 to 20/6
(1) Spanish	20/6 to 21/–
N.E. COAST—	
Native	18/– to 21/–
Foreign (c.i.f.)	16/–

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 17 0	—
No. 1 Foundry	3 19 0	—
No. 3 Foundry	3 16 6	—
N.E. COAST—		
Hematite Mixed Nos.	3 11 0	3 11 0
No. 1	3 11 6	3 11 6
Cleveland—		
No. 1	3 6 0	3 6 0
Siliceous Iron	3 6 0	3 6 0
No. 3 G.M.B.	3 3 6	3 3 6
No. 4 Foundry	3 2 6	3 2 6
No. 4 Forge	3 2 0	3 2 0
Mottled	3 1 6	3 1 6
White	3 1 6	3 1 6
MIDLANDS—		
(c) Staffs.—	(*Delivered to Station.*)	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 6 0	—
„ „ Foundry	3 11 0	—
(c) Northampton—		
Foundry No. 3	3 7 6	—
Forge	3 2 6	—
Derbyshire—		
No. 3 Foundry	3 11 0	—
Forge	3 6 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 3 6 (*a*), 4 5 6 (*b*), 4 10 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 10 0	—
Common Bars	10 15 0	—
Best Bars	11 5 0	—
Double Best Bars	11 15 0	—
Treble Best Bars	12 5 0	—
LANCS.—		
Crown Bars	10 5 0	—
Second Quality Bars	8 15 0	—
Hoops	13 0 0	—
S. YORKS.—		
Crown Bars	10 5 0	—
Best Bars	11 0 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	10 0 0 to 10 7 6	—
Marked Bars (Staffs.)	12 10 0	—
Nut and Bolt Bars	9 0 0 to 9 5 0	—
Gas Tube Strip	10 17 6 to 11 0 0	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	10 10 0	10 10 0
„ „ (Land)	10 0 0	10 0 0
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	8 15 0	8 15 0
Sheets (Gal. Cor. 24 B.G.)	11 7 6	11 5 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 10 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 10 0	—
Light Rails	8 15 0 to 9 0 0	—
Billets	6 15 0 to 9 10 0	—
MANCHESTER—		
Bars (Round)	9 7 6	—
„ (Small Round)	7 7 6	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	9 7 6	—
SHEFFIELD—		
Siemens Acid Billets	9 10 0 (basis)	—
Hard Basic	9 2 6 and 9 12 6	—
Intermediate Basic	7 12 6 and 8 2 6	—
Soft Basic	6 10 0	—
Hoops	10 5 0	—
Soft Wire Rods	8 0 0	—
MIDLANDS—		
Small Rolled Bars	7 7 6 to 8 5 0	—
Billets and Sheet Bars	5 12 6 to 6 10 0	—
Galv. Sheets, f.o.b. L'pool	11 5 0	—
(2) Staffordshire Hoops	10 0 0	—
Angles	8 7 6	—
Joists	8 10 0	—
Tees	9 7 6	—
Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 7 6 to 9 10 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14 f.o.b.	15/9 to 16/–
Block Tin (Cash)	111 12 6
„ (three months)	112 17 6
Copper (cash)	46 15 0
„ (three months)	46 15 0
Spanish Lead (cash)	15 8 9
„ „ (three months)	15 10 3
Spelter (cash)	13 16 3
„ (three months)	14 6 3
MANCHESTER—	
Copper, Best Selected Ingots	50 10 0
„ Electrolytic	53 0 0
„ Strong Sheets	84 0 0
„ Tubes (Basis Price), lb.	0 1 0
Brass Tubes (Basis Price), lb.	0 0 10½
„ Condenser, lb.	0 1 0½
Lead English	16 17 6
„ Foreign	16 0 0
Spelter	14 7 6
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	2/6 per lb.	
Ferro Tungsten	2/3 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 5 6	7/–
„ „ 6 p.c. to 8 p.c.	£22 10 0	7/–
„ „ 8 p.c. to 10 p.c.	£22 0 0	7/–
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£33 0 0	10/–
„ „ „ 1 p.c. carbon	£38 0 0	13/–
„ „ „ 0·70 p.c. carbon	£41 0 0	14/–
„ „ „ carbon free	11d. per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£11 15 0 for home	
„ „ „	£11 5 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£11 10 0 unit	scale 5/– per
„ „ 75 p.c.	£18 0 0 unit	scale 7/– per
„ Vanadium	12/9 per lb.	
„ Molybdenum	4/2 per lb.	
„ Titanium (carbon free)	11d. per lb.	
Nickel (per ton)	£170 to £175	
Ferro Cobalt	9/6 per lb.	

FUELS.

SCOTLAND.

(*No Quotations this week.*)

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	—
„ „ Ell	—
„ „ Splint	—
„ „ Trebles	—
„ „ Doubles	—
„ „ Singles	—
AYRSHIRE—	
(f.o.b. Ports)—Steam	—
„ „ Jewel	—
„ „ Trebles	—
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	—
Screened Navigation	—
Trebles	—
Doubles	—
Singles	—
LOTHIANS—	
(f.o.b. Leith)—Best Steam	—
Secondary Steam	—
Trebles	—
Doubles	—
Singles	—

ENGLAND.

(8) N.W. COAST—	
Steams	20/6 to 21/–
Household	32/6 to 53/6
Coke	21/– to 22/–
NORTHUMBERLAND—	
Best Steams	13/9 to 14/3
Second Steams	13/– to 13/3
Steam Smalls	10/– to 10/6
Unscreened	12/6 to 13/–
Household	25/– to 37/–
DURHAM—	
Best Gas	15/–
Second	13/6
Household	25/– to 37/–
Foundry Coke	24/– to 26/–

SHEFFIELD—	Inland.
Best Hand-picked Branch	25/6 to 27/– —
Derbyshire Best Bright House	20/– to 22/6 —
Best House Coal	20/6 to 21/6 —
Screened House Coal	18/– to 19/– —
„ „ Nuts	15/6 to 16/6 —
Yorkshire Hards	14/– to 15/6 —
Derbyshire Hards	14/– to 15/6 —
Rough Slacks	8/6 to 9/– —
Nutty Slacks	6/6 to 7/– —
Smalls	3/– to 5/– —
Blast-furnace Coke (Inland)	11/– on rail at ovens
Furnace and Foundry Coke (Export), f.o.b.	15/6 to 16/–

(9) SOUTH WALES.

CARDIFF—	
Steam Coals :	
Best Smokeless Large	20/–
Second Smokeless Large	18/9 to 19/9
Best Dry Large	18/6 to 18/9
Ordinary Dry Large	17/6 to 18/–
Best Black Vein Large	18/3 to 18/6
Western Valley Large	18/– to 18/3
Best Eastern Valley Large	17/7½ to 17/9
Ordinary Eastern Valley Large	17/6 to 17/7½
Best Steam Smalls	13/3 to 13/9
Ordinary Smalls	11/6 to 12/9
Washed Nuts	17/6 to 21/6
No. 3 Rhondda Large	20/– to 20/6
„ „ Smalls	15/6 to 16/–
No. 2 „ Large	17/– to 17/3
„ „ Through	16/– to 16/6
„ „ Smalls	14/– to 14/3
Foundry Coke (Export)	27/6 to 35/–
Furnace Coke (Export)	17/6 to 20/–
Patent Fuel	21/6
Pitwood (ex ship)	28/– to 28/6
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	35/– to 37/6
Seconds	27/– to 31/6
Red Vein	23/6 to 27/–
Machine-made Cobbles	41/6 to 45/–
Nuts	40/– to 46/–
Beans	24/6 to 28/–
Peas	20/3 to 21/6
Breaker Duff	9/9 to 10/3
Rubbly Culm	9/– to 9/6
Steam Coals :	
Large	19/6 to 21/6
Seconds	18/– to 19/6
Smalls	12/– to 13/–
Cargo Through	15/6 to 16/–

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate : Joists (minimum), 12/6 ; Ordinary Ship, Bridge, and Tank Plates and Sections, 10/– if home consumers confine purchases from associated British Steel Makers. (*e*) Delivered Black Country Stations.

French Engineering Notes.

(From our own Correspondent in Paris.)

The Trade Situation.

THE official figures of unemployment have always presented the situation in a favourable light, and the fact that so much foreign labour should be imported indicated a state of things which seemed to place this country beyond reach of the troubles experienced elsewhere. Of late, however, matters have taken a somewhat disquieting turn. The figures of unemployed in receipt of relief are increasing, although the proportion of unemployed to the whole is still very small. Nevertheless, the men's unions have found it necessary to ask Government to adopt measures of protection, particularly in the way of restricting the introduction of foreign labour and inducing employers to limit the number of working days rather than to discharge men. This fairly explains the industrial situation as it is at present. There is a continuous slowing down of activity and factories are running short time, but there is nothing yet in the nature of a crisis, because a good deal of work continues to be distributed by the railway companies, State Departments and for public works. Hope is further buoyed up by the national scheme of public undertakings, both at home and in the colonies. On the other hand, the engineering trades are looking uneasily to the changes that are taking place in other continental countries where production is cheapened with lower wages and selling prices are reduced, while in Germany it is affirmed that heavy reductions are made for export, to the extent that competition for business in foreign markets has become extremely arduous. All this is making the outlook very unsatisfactory, and French manufacturers do not yet see how they can meet the situation. So far as concerns the iron and steel trades, everything turns upon the results of meetings being held in Paris this week. It is hoped that some definite advance will be made in the negotiations for the renewal of the Steel Cartel.

Shipbuilding.

The grouping of fourteen shipyards in the Consortium National des Constructeurs Navals is the first definite step towards the rationalisation of the French shipbuilding industry, the main lines of which have already been laid down in accordance with the recommendations of the Conseil National Economique. Three yards that were created after the Armistice at Harfleur, Havre and Couëron, in the belief that there would be a boom in shipbuilding, have been closed down. Two others have been amalgamated at Bordeaux, and others at Dunkirk and Caen have been reorganised financially with the aid of different shipbuilding companies. The great trouble with the French shipyards is that they are situated at a considerable distance from the sources of raw material supply, and the arrangements now being made aim at facilitating the supply of cheaper material by standardising the dimensions of ship plates and sections so that French mills and forges will be able to deliver them more promptly. Not only are there to be fewer sections, but it is intended to standardise ships and small craft, and all the yards will work in collaboration so that they will give mutual help when necessary in order to secure the greatest economy. There will also be an organisation for securing and distributing foreign orders. Having done all it can to reduce costs, the Consortium National des Constructeurs Navals will be in a better position to obtain from the Government the further financial aid which shipbuilders affirm is necessary if they are to meet foreign competition. While this is in progress some shipowners are declared to be in negotiation with a German firm for the supply of ships on account of reparations to the value of 5 million marks. Under present circumstances it is doubtful whether Government will sanction the contract.

The Navy.

The programme of naval construction is sufficiently advanced to provide not only for the reorganisation of the Mediterranean fleet, but also for the creation of divisions and light squadrons to protect the lines of colonial communication. Meanwhile the shipbuilding programme continues to be carried through normally. At Lorient the 2400-ton destroyer "Vautour" and the 600-ton submarine "Méduse" were recently launched, the former being one of six of the same class, and another, the "Epervier," is well advanced. Three others are being completed, and the "Milan" is to be put on the stocks almost at once. These boats have a displacement 2480 tons. Their turbines develop 70,000 horse-power and they are expected to steam at 38 knots. The armament consists of five 138 mm. guns, one of 75 mm., four anti-aircraft guns of 37 mm., four Thornycroft mortars for depth charges and six torpedo tubes. Work will soon be started upon the 10,000-ton cruiser "Algerie" on the stocks at Brest, from which the "Dupleix" was recently launched. Various squadrons have now been formed to visit periodically the different colonial bases. There will be a group of submarines at Saigon. Another group will visit the bases at Dakar, Fort de France and Diego-Suarez. A light squadron, including the cruisers "Foch" and "Colbert" and several new destroyers, will cruise in the Indian Ocean and eventually in the Pacific. A division consisting of 10,000-ton cruisers and a light squadron of 8000-ton cruisers and destroyers will cruise in the North Atlantic, as well as along the West Coast of Africa and in the South Atlantic.

Motor Barges.

While the number of barges on the inland waterways is decreasing, there is a steady increase in the number of motor barges which are carrying a larger amount of goods on account of the accelerated traffic. The barges at present in service number 14,759, which is 1120 less than last year. The number of motor barges is now 2345. Many owners are only deterred from fitting internal combustion engines to their boats by the cost, and as it is now seen that motor traffic by water is inevitable if the rivers and canals are to compete with the railways, barge owners are hoping to get financial assistance from the State for the conversion of their fleet into motor barges.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

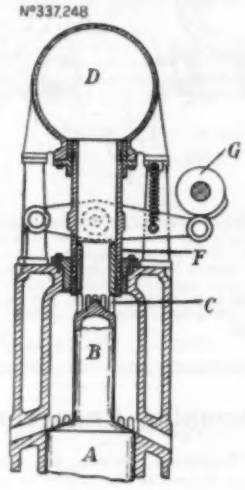
The date first given is the date of application; the second date at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

337,248. December 2nd, 1929.—TWO-STROKE ENGINES, H. F. P. Purday, Harland and Wolff, Ltd., Belfast, and F. E. Rebbeck.

The aim of this invention is to arrange that in a two-stroke engine the exhaust ports shall open before the inlet ports and

N°337,248



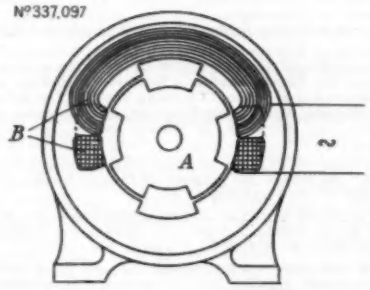
close simultaneously. The piston A is provided with a hollow tail-rod B, through which the exhaust escapes by way of the ports C to the exhaust main D. The tail-rod B is embraced by a sleeve F, which is operated by the cam gear G in such a manner that the desired sequence of events takes place.—*October 30th*, 1930.

DYNAMOS AND MOTORS.

337,097. August 13th, 1929.—SYNCHRONOUS MOTORS, C. Lorenz Aktiengesellschaft, of 1, Lorenzweg, Berlin-Tempelhof, Germany.

According to this invention, a single-phase synchronous motor is provided wherein the stator is energised by coils fed with single-phase current and the stator poles are provided with teeth having the same angular pitch as the teeth of the rotor, so arranged that all the stator teeth lie simultaneously opposite corresponding rotor teeth, the stator and rotor being permeated by an alternating flux. A is the rotor of the machine which is provided with four teeth and which moves inside the main poles of the stator. In each of these poles a slot is provided

N°337,097

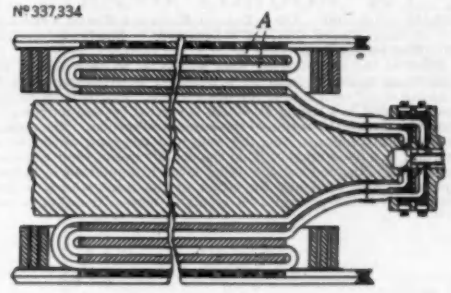


which divides the poles into divisions corresponding to the teeth of the rotor. In this way each pole is divided into two sub-poles. B is the exciting winding, which is fitted over the main poles of the stator and supplied with alternating current. The speed of the machine is determined by the number of teeth into which the rotor is subdivided. The machine works without D.C. excitation, but in the particular form illustrated it is not self-starting. Another scheme which enables the motor to run up to speed on its own accord is, however, described.—*October 30th*, 1930.

337,334. March 14th, 1930.—IMPROVED MEANS FOR COOLING THE ROTORS OF DYNAMO-ELECTRIC MACHINES, Ing. Dr. Kalman Von Kando, VI., Rozsa u. 46, Budapest, Hungary.

It has already been proposed to cool the rotors of dynamo-electric machines by means of a liquid, which is led through cooling pipes inserted in the rotor body. The object of this invention is to provide an arrangement in which the pipes may be inserted and replaced easily and with as little disturbance as possible to the other parts of the rotor, while, at the same time, ensuring a satisfactory removal of heat. The cooling pipes A are placed in slots in the rotor body, the slots opening towards the rotor periphery, but being closed by wedges and lying between the slots intended for the reception of the winding, so that the pipes form channel loops the inlet and outlet ends of which are situated on the same end of the rotor. The loops may be formed by bending a single pipe, or by dividing a flat pipe, occupying the entire section of the slots, by means of partitions. These loops of cooling pipe may possess a flattened section, the diameter lying longitudinally to the cooling pipe slots being greater than the diameter lying transversely to these slots. The pressure set up in the cooling liquid by the centrifugal force tends to make the flattened section of the cooling pipes into a circular shape, thereby pressing the walls of the pipes firmly against the side walls of the cooling pipe slots. Consequently, the cooling pipe may be made slightly narrower than the cooling pipe slots to permit of easy insertion and replacement of the loops of pipe. When the rotor is running, the cooling pipes, which are loose when the rotor is at rest, are held firmly in the slots by the pressure produced in the pipes, since, as the

N°337,334



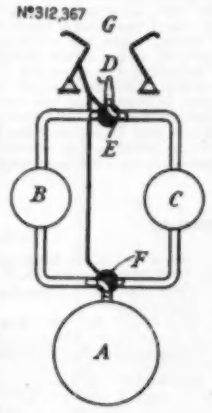
centrifugal force increases, so does the squeezing action exerted by the pressure of the liquid. Thus the centrifugal force, as it increases, ensures the tight seating of the loops of cooling pipe, and, therefore, the satisfactory removal of heat also. The insertion and removal of the loops of cooling pipe are facilitated still further by making the connecting limbs of the loops of cooling pipe inclined or curved in a convex manner against the rotor body.—*October 30th*, 1930.

SWITCHGEAR.

312,367. May 24th, 1929.—EXTINGUISHING THE ARC IN ELECTRIC SWITCHES BY MEANS OF COMPRESSED AIR, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

This specification describes a means of blowing out the arc at the contacts of a switch. In the drawing A is a main air container, and B and C two auxiliary containers, capable of supplying air to a nozzle D. At E and F there are cocks, which are connected together and with contacts of a switch G. When the air passage is opened from one auxiliary container to the nozzle, the air passage from the second auxiliary container to the nozzle is closed, while, at the same time, the second auxiliary container is connected with the main container and the first auxiliary air container is separated therefrom. When, therefore the switch is opened, the auxiliary container C is connected to the nozzle and blows out the arc. The auxiliary container B is, at the same time, connected to the main container and is thus filled up. The coupling between the two cocks is so arranged that each position of one cock corresponds to a particular position of the other cock. If, therefore, the cock E connects the container C with the nozzle D, then the cock F necessarily connects the container B with the main container A. An arrangement is shown in which the cocks are intended for a reciprocating movement, which, on each occasion, represents a turning or revolution of 90 deg. In this case the air container C is intended for a blowing when the switch is opened, whilst the air container B suppresses switching-in arcs. At the point shown the contacts are open.

N°312,367



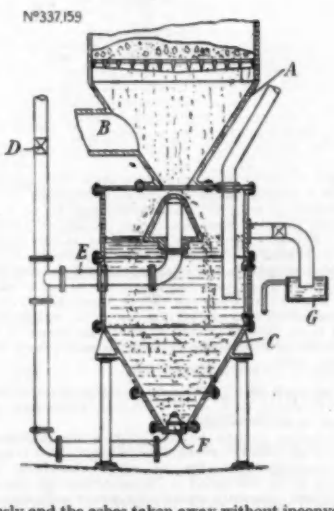
Hence, by means of the cock E, the container C is connected with the nozzle D, so that this latter blows upon the arc. In closing the contacts again the cocks E and F are moved in an anti-clockwise direction. Owing to this the container B is connected with the nozzle, so that the contacts are again swept round by a current of compressed air, which suppresses switching-in arcs. At the same time, the container C is connected by the cock F with the main container A, whilst the nozzle of the container C is closed by means of the cock E, so that the container C is again filled up and is ready for a fresh switching-out operation.—*October 24th*, 1930.

GAS PRODUCERS.

337,159. October 2nd, 1929.—ASHPITS OF WATER-GAS GENERATORS, *The Ash Company (London), Ltd., 63, Lincoln's Inn-fields, London, W.C. 2.*

The object here is to enable a water-gas plant to be run

N°337,159



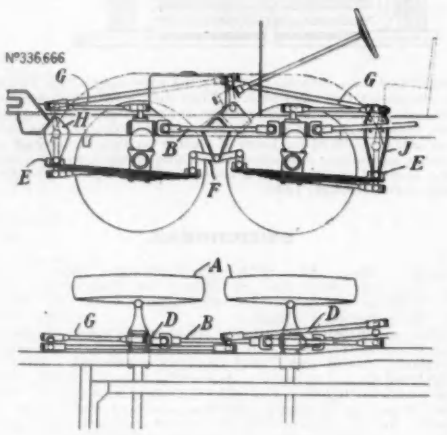
continuously and the ashes taken away without inconvenience or danger to the workmen. The producer terminates in a hopper bottom A, to which air is supplied by the branch B. Below, there is a second hopper C, filled with water, into which the ashes

drop. When it is desired to discharge the ashes high-pressure water is turned on at D. The water pressure in the branch E forces the cone, which fits over its aperture, upwards and seals the opening from the producer, while the jet F drives the ashes out through the syphon and water seal G.—*October 30th*, 1930.

MOTOR CARS AND ROAD TRAFFIC.

336,666. July 19th, 1929.—TORQUE RODS FOR MOTOR VEHICLES, Sydney Slater Guy, of "Delamere," Newbridge-avenue, Wolverhampton.

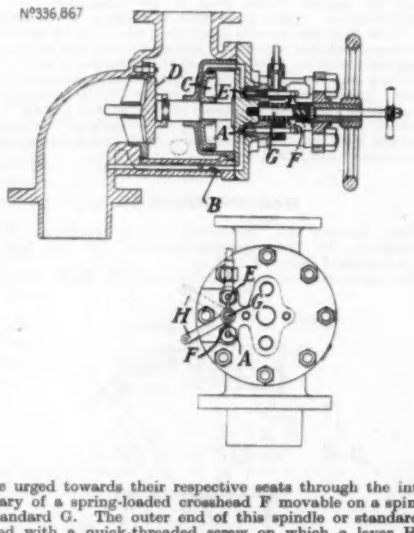
Each of the two steering road wheels A, at each side of the vehicle, is operated from an articulated longitudinal shaft B, running along each side of the main frame. The drive is in each case enclosed in a casing D, which is carried by and moves with the axle against the action of the laminated springs. The springs are pivotally mounted on the axle and are each anchored at one end to a fixed bracket E on the chassis frame, their adjacent ends being shackled to a rocking lever F supported in a fixed bracket. Any tendency for either of the front wheels to lose contact with the ground as a result of torque reaction is prevented by means of horizontally arranged torque rods, one—G—of which is pivotally carried off the axle, as by means of the casing D of the forward wheel and runs forward to a bracket H rigidly secured to the chassis frame, whilst the other is similarly carried off the rearmost axle by means of the casing D of the rearmost wheel and runs backwardly to a bracket J, also rigidly secured to the chassis frame. The arrangement is such that the forward torque rod acts in tension and the rear torque rod in compression. In each case the torque rod and spring of each wheel form, together with the axle casing and fixed bracket, an articulated parallelogram, in which torque reaction is taken by the fixed bracket, or frame, through the horizontal torque rods.—*October 26th*, 1930.



MISCELLANEOUS.

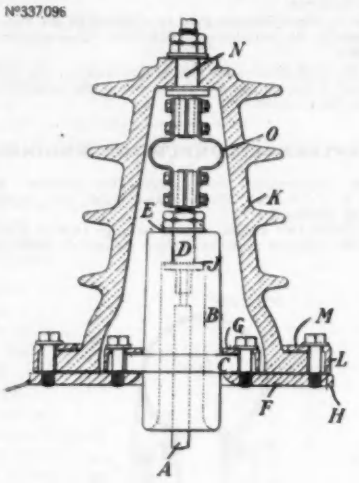
336,867. December 13th, 1929.—CONTROL VALVE DEVICES FOR CONTROLLING EMERGENCY SHUT-OFF VALVES, Cockburns, Ltd., and Donald MacNicoll, both of Clydesdale Engineering Works, Cardonald, near Glasgow.

This invention relates to control valve devices for controlling any type of emergency valve operated by a piston. The control valve device comprises a fluid pressure supply valve A controlling the supply of fluid admitted by the inlet connection B to one side of the piston C operatively connected to the emergency valve D, and a fluid pressure exhaust valve E controlling the exhaust from the other side of the piston C. The valves A and E are urged towards their respective seats through the intermediary of a spring-loaded crosshead F movable on a spindle or standard G. The outer end of this spindle or standard is formed with a quick-threaded screw on which a lever H is movable. Normally, the lever H is clear of the crosshead F, but, when it is desired to close the emergency valve D, the lever H is moved through an angle of approximately 45 deg. in a direction that causes it to traverse the screw so as to engage the crosshead F, and thus open the valves A and E. Fluid pressure is now supplied to one side of the piston C, and fluid pressure exhausted from the other side so that the piston C is moved in the direction substantially to close the emergency valve D.—*October 23rd* 1930.



337,096. August 12th, 1929.—ELECTRICAL INSULATOR BUSHINGS, Ferranti, Ltd., of Hollinwood, Lancaster, and John Turner, of the same address.

This invention relates to insulator bushings for electrical apparatus of all kinds, for example, oil-immersed transformers, induction regulators, condensers, surge absorbers, &c. The conductor A to be insulated is brought through the centre of the inner plain porcelain sheath B, which embodies a flange C and is connected to a terminal stem D, fitted to the upper end of the sheath. The upper and lower surfaces of the flange C are flat and smooth, and are adapted to be clamped in oil-tight fashion between a ring G and the surface F traversed by the conductor, this surface forming part of a casing H containing oil-immersed electrical apparatus. The terminal stem D is also clamped against flat surfaces E, J at the upper end of the sheath B. This form of oil-tight joints with flat porcelain surfaces is very easy to make and quite simple to maintain. An outer porcelain shell K is provided and it also has flat surfaces enabling its lower end to be clamped by a clamping ring L and washer M to the traversed surface in oil-tight fashion.



This outer shell may be furnished with rain sheds if desired for outdoor use. The upper end of the outer shell is also furnished with a terminal stem N clamped thereto, the conductor stem D being connected thereto by flexible leads O. The space between the inner and outer porcelain is filled with oil or compound, leaving a small air space for expansion. The outer shell being of relatively large diameter is extremely robust mechanically.—*October 30th*, 1930.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

DIESEL ENGINE USERS ASSOCIATION.—At Caxton Hall, Westminster. "Waste Heat Recovery from Internal Combustion Engines, with Particular Reference to Marine Oil Engines," by Major W. Gregson. 3.30 p.m.

ILLUMINATING ENGINEERING SOCIETY.—In the Lecture Theatre of Holophane, Ltd., Elverton-street, Vincent-square, Westminster, S.W. 1. "Glasses for Use with Invisible (Ultra-violet and Infra-red) Rays," illustrated by demonstrations, by Dr. S. English. 6.30 p.m. Prior to this meeting a special visit to the Chiswick works of the London General Omnibus Company, Ltd., for the purpose of inspecting the lighting arrangements, has been arranged. 4 p.m.

INSTITUTE OF FUEL.—Technical College, Green-lane, Derby. East Midlands Section meeting. "Some Factors Influencing the Design of a Combustion Chamber for Pulverised Fuel," by Mr. T. F. Hurley. 7.30 p.m.

INSTITUTE OF INDUSTRIAL ADMINISTRATION.—At the Institute of Hygiene, 28, Portland-place, London, W. 1. Discussion on "Education for Management." The President, Mr. A. S. Comyns Carr, will open the discussion with an address. 5.30 p.m.

INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—In the Non-ferrous Section of the Applied Science Department, the University, St. George's-square, Sheffield. "Studies in the Electro-deposition of Silver: Throwing Power: The Behaviour of Silver Anodes, with Special Reference to Blackening and its Prevention," by Mr. R. N. D. Barklie and Mr. A. E. Nicol. 7.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: NORTH-EASTERN STUDENTS' SECTION.—At Armstrong College. "Insulation," by Professor W. M. Thornton. 7.15 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, St. James's Park, London, S.W. 1. "X-rays in Engineering Practice," by Dr. V. E. Pullin. 6 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—At the Royal Society of Arts, John-street, Adelphi, W.C. 2. Presentation of awards by Sir Ernest Moir and induction of new President, Colonel Sir Henry George Lyons, F.R.S. Presidential address, "Technical Museums and their Value to Engineers." 7.30 p.m.

KEIGHLEY ASSOCIATION OF ENGINEERS.—Queen's Hotel, Keighley. Annual inter-lecture with the Keighley Textile Society, "Electrical Driving of Textile Machinery," by Mr. A. Brier. 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—In the Lecture Theatre of the Mining Institute, Newcastle-on-Tyne. "Refractories for Boiler Furnaces," by Mr. W. J. Rees. 6 p.m.

SMITHFIELD CLUB SHOW, 1930.—Agricultural Hall, Islington, N. Annual Show. 9 a.m. to 9 p.m.

TO-DAY AND SATURDAY, DECEMBER 13TH.

BOROUGH POLYTECHNIC.—Borough-road, S.E. 1. Exhibition of Students' Work. Friday, 6 p.m. to 9 p.m.; Saturday, 2.30 p.m. to 9.30 p.m.

SATURDAY, DECEMBER 13TH.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS.—In the Lecture Theatre of the Institute, Newcastle-upon-Tyne. Discussion: "Machine Mining in Faulted Ground," by Mr. Alan L. Ford; "A Record of the Upper Carboniferous Non-marine Lamellibranchs of Northumberland and Durham, and a Record of their Sequence," by Mr. William Hopkins. The following paper will be read, "Some Recent Improvements in Surveying Instruments," by Mr. W. H. Connell. 2.30 p.m.

MONDAY, DECEMBER 15TH.

BRADFORD ENGINEERING SOCIETY.—Visit to the Bradford Corporation Electricity Showrooms, Sunbridge-road, at 7.30 p.m.

INSTITUTE OF FUEL.—Engineers' Club, Albert-square, Manchester. Joint meeting with the Institution of Electrical Engineers, the Institution of Mechanical Engineers, and the Association of Engineers. North-Western Section meeting. "Private Generation of Electricity *versus* the Grid," by Major E. Ivor David. 7 p.m.

INSTITUTE OF TRANSPORT.—15, Savoy-street, Victoria Embankment, London, W.C. 2. "Transportation and Harbour Development in South Africa," by Sir John E. Thornycroft. 6 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, St. James's Park, London, S.W. 1. Graduates' Section, London. Joint meeting with Students' Sections of the Institution of Civil Engineers and the Institution of Electrical Engineers. "Industrial Psychology," by Mr. W. H. Evans. 6.45 p.m.

TUESDAY, DECEMBER 16TH.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, S.W. 1. Discussion, "The Opening-out of Cofton Tunnel, London, Midland and Scottish Railway," by Mr. Robert Towson McCallum. 6 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: SCOTTISH CENTRE. At the North British Station Hotel, Edinburgh. "Modern Developments of the Metal-cylinder Mercury-Arc Rectifier," by Mr. G. Henderson. 7 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: SOUTH MIDLAND STUDENTS' SECTION.—At the University, Edmund-street, Birmingham. "The Relation Between Engineering and Economics," by Mr. F. J. Saunders. 7.30 p.m.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.—Elmbank-crescent, Glasgow, C. 2. "Some Notes on Electrical Propulsion for Small Vessels," by Mr. W. H. Woolnough. 7.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS: YORKSHIRE BRANCH.—Hotel Metropole, Leeds. "Obsolescence and Organisation," by Major F. L. Watson. The President of the Institution, Mr. Loughnan St. L. Pendred, has arranged to visit the Branch on this occasion.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—In the Cleveland Scientific and Technical Institution, Middlesbrough. Tees-side Branch, Graduate Section. "Metallography of Some Engineering Materials," by Mr. J. Lang. 7.30 p.m.

TUESDAY AND WEDNESDAY, DECEMBER 16TH AND 17TH.

SOCIETY OF GLASS TECHNOLOGY.—Tuesday, evening: Committee and Council meetings in the Grafton Hotel, Tottenham Court-road, W.C. 1. Wednesday, morning: Visit to the Building Research Station, Garston, near Watford. 2 p.m.: general meeting, University College, Gower-street, W.C. 1. General discussion on "The Flow of Glass in Tank Furnaces," preliminary statement by Mr. B. P. Dudding; Messrs. E. A. Coad-Pryor, A. L. Marden and J. B. Murgatroyd will report the results of some experiments made by the staff at the works of United Glass Bottle Manufacturers, Ltd., Osram G.E.C. Glass Works, and Rockware Glass Syndicate, Ltd. 7 p.m.: Informal dinner of the London Section, Old Ship Tavern, Ivy-lane, Newgate-street, E.C. 1.

WEDNESDAY, DECEMBER 17TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—The Engineering and Scientific Club, Queen-street, Wolverhampton. "Machine Tools from the Users' Point of View," by Mr. H. C. Armitage. 7.30 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS (LONDON).—Denison House, 296, Vauxhall Bridge-road, Westminster, S.W. 1. "The Possibilities of Condensing on Locomotives," by Mr. H. I. Andrews. A discussion will follow the reading of the paper, which will be illustrated by lantern slides. 6 p.m.

NEWCOMEN SOCIETY.—At Prince Henry's Room, 17, Fleet-street, E.C. "Cornish Mining: Notes from the Account Books of Richard Trevithick, sen.," by Mr. A. Titley. The original documents will be shown by Mr. R. E. Trevithick, member. 5.30 p.m.

ROYAL METEOROLOGICAL SOCIETY.—49, Cromwell-road, South Kensington. "Heavy Falls of Rain in Short Periods (Two Hours or Less)," by Dr. John Glaspoole; "An Analysis of the Cold Front Over Egypt on March 7th, 1929," by Mr. W. D. Flower; "The Factors Affecting Visibility at Valentia Observatory," by Mr. M. T. Spence. 5 p.m.

ROYAL MICROSCOPICAL SOCIETY.—In the Hastings Hall, B.M.A. House, Tavistock-square, W.C. 1. Ordinary meeting at 5.30 p.m.

THURSDAY, DECEMBER 18TH.

INSTITUTION OF ELECTRICAL ENGINEERS.—In the Lecture Theatre of the Institution, Savoy-place, Victoria Embankment, W.C. 2. "The Theory and Performance of Phase Advancers," by Dr. J. J. Rudra and Professor Miles Walker. 6 p.m.

FRIDAY, DECEMBER 19TH.

CRYSTAL PALACE SCHOOL OF PRACTICAL ENGINEERING.—174th award of certificates. Mr. C. P. Sandberg will take the chair at 3 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Informal meeting. "Well Drill Blasting," by Mr. W. Cullen. 7.30 p.m.

MONDAY, DECEMBER 22ND.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Institution of Engineers and Shipbuilders, 39, Elmbank-crescent, Glasgow. "Trends in the Transmission," by Dr. H. E. Merritt. 7.30 p.m.

THURSDAY, DECEMBER 25TH.

CHRISTMAS DAY.

TUESDAY, DECEMBER 30TH.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Christmas lecture, "The Electric Spark: (i) Some Properties of Electrified Bodies," by Professor A. M. Tyndall. 3 p.m.

1931.

THURSDAY, JANUARY 1ST.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Christmas lecture, "The Electric Spark: (ii) The Spark as a Current of Electricity," by Professor A. M. Tyndall. 3 p.m.

FRIDAY, JANUARY 2ND.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, St. James's Park, London, S.W. 1. Extra general meeting. "An Experimental Investigation into Induction Conditions, Distribution, and Turbulence in Petrol Engines," by Mr. S. J. Davies. 6 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Informal meeting. "Weighing Machinery," by Mr. W. A. Benton. Illustrated by slides and exhibits. 7.30 p.m.

SATURDAY, JANUARY 3RD.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Christmas lecture, "The Electric Spark (iii) Air as a Conductor of Electricity," by Professor A. M. Tyndall. 3 p.m.